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New Circular Saw Table and Horizontal Boring Machine.

The two engravings upon this page represent a circular saw table and a horizontal boring mill, both of which are of new design and made by P. Pryibil, 461 to 467 West 40th Street, New York.

The saw table, although suitable for wood, was designed more particularly for metal, ivory, horn, and tortoise shell.

The saw table is held in a swinging frame, which may be adjusted to different heights, and held securely by a clamping screw, as shown.

The table is set upon an iron box, which catches the sawdust and holds water for the saw to run in. This box is provided with a hand-hole plate at the bottom, for emptying and cleaning. The table is provided with an adjustable gauge, besides a carriage with miter fence. A removable throat piece gives access to the saw and provides for the use of a wabble-saw or groover. In setting up this machine, the saw mandrel should be set midway between its highest and lowest working positions. The countershaft must then be placed on a line with the center of the saw mandrel and the shaft on which the arbor frame swings. By observing this precaution the tension of the belt will not be affected by raising and lowering the saw arbor.

The horizontal boring machine here shown, is adapted to a very large variety of work, including rosette cutting and mortising. The latter is done by a cutter, cutting at both ends and sides, producing when the work is moved sidewise, a mortise with half round ends.

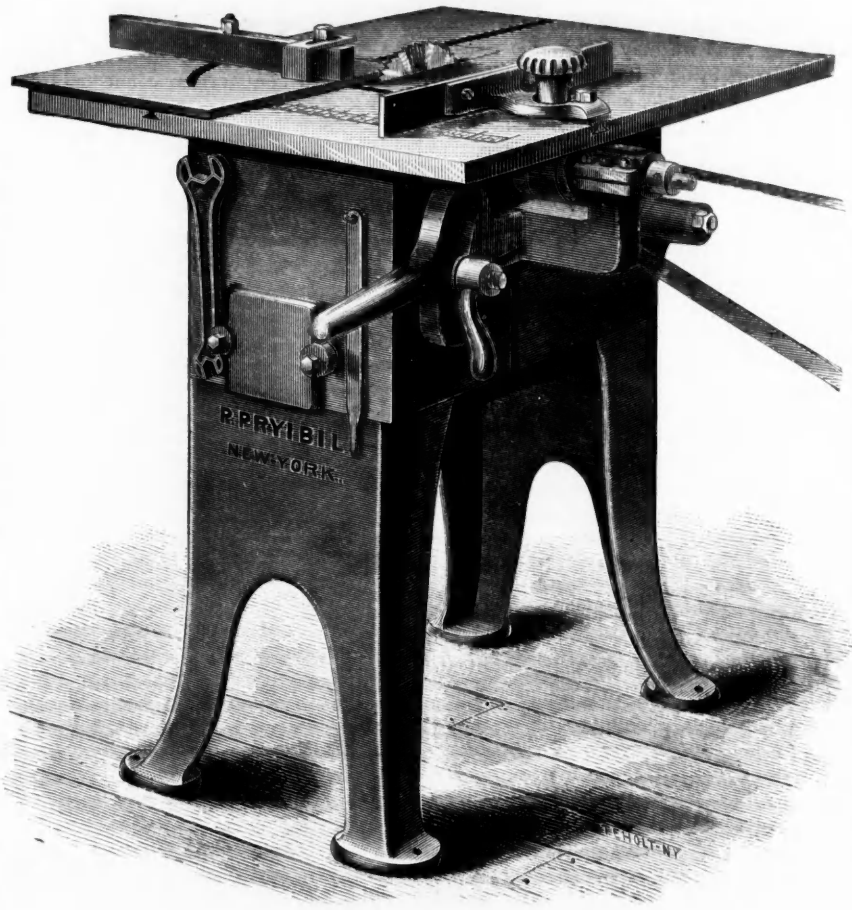
The spindle is of steel, fitted to a steel tube, with which it revolves and in which it slides. The wear is thus confined to the tube, where it can be easily taken up by the adjustable caps. When spindles slide in the same bearings in which they revolve, they become smaller at one part than at another, and a perfect adjustment is then impossible.

The spindle has a longitudinal movement of 6″, and is provided with an adjustable gibbed stop collar. The table has a movement of 10″ in the direction of the length of the spindle, to enable it to be set close to bits of various lengths, and to enable rosette and mortising cutters to be used close to the bearings. It also has a vertical movement of 12″, and a lateral movement of 14″. The latter is effected through the hand wheel in front, and its extent can be limited by two adjustable stops provided for that purpose.

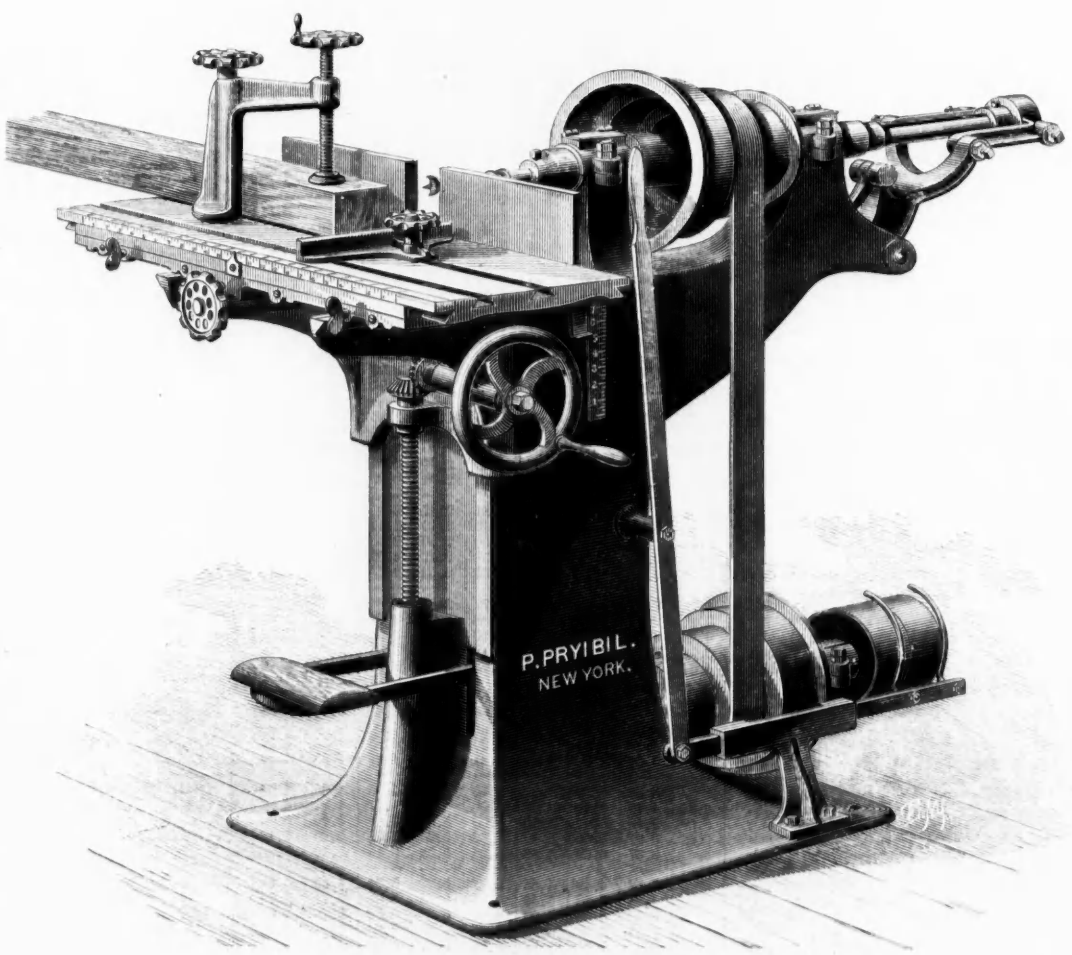
The table has an adjustable square and miter gauge, an adjustable clamp and an iron fence with tapered dove-tailed ends for facilitating the application of special wooden fences, also with scale for setting to required sizes. All the slides have adjustable gibs, and the main bearings adjustable caps.

The height of the treadle is adjustable, to enable the operator to set it low when boring short holes, in order to prevent raising the foot unnecessarily high.

The loose pulley is self-oiling, and the machine may be driven from above, below, or from either side. The belt-shifter is fitted to both sides of the machine, so that it can be used either way, and the fork may be turned up or down, to accommodate all possible positions of the belt. This machine weighs about 735 pounds.



NEW CIRCULAR SAW TABLE.



NEW HORIZONTAL BORING MACHINE.

The Heating of Journals.

EXTRACTS FROM A PAPER READ BEFORE THE MECHANICAL ENGINEERING SECTION OF THE FRANKLIN INSTITUTE.

The cause of overheating of properly lubricated journals of machinery is derived principally from uneven texture in the materials in contact, and from the wearing surfaces not being properly fitted and in line.

Shaft journals made from puddled iron are never even in texture, and are therefore difficult to keep cool when overstrained by pressure and velocity, whilst cast steel or cast iron journals, which are invariably of more even texture, would run cool under similar circumstances.

Puddled iron is first produced in the form of a ball containing iron and slag in a semi-fluid or plastic state. The slag is composed of silica and oxide of iron. The puddle ball, in a welding heat, is taken from the furnace to a squeezer in which the greater portion of the slag is squeezed out of the ball, which is then passed through a rolling mill and rolled into the form of a bar. Some slag is also squeezed out between the rollers, but much of it still remains, on account of not being fluid enough to be forced out. The bar iron so produced is cut into proper lengths, and formed into packets, which are reheated to a welding heat, when more slag is forced out of it under a hammer; but, however many times this process is repeated, some slag still remains, and causes the appearance of fiber in broken wrought iron.

It is evident from the nature of this process that it is difficult, if not impossible, to produce iron of an even texture thereby, the result of which is that however well a journal of such iron may be fitted, when overstrained in transmitting power, it expands out of shape, and thus generates the heat complained of; whilst a shaft journal made of cast steel, cast iron, or of Bessemer steel or other homogeneous metal, will not generate heat under similar circumstances.

To overcome this difficulty with ordinary iron journals, the boxes are made of soft metal, which accomodates itself to a certain extent to the irregularities of the journal, but this remedy has not given full satisfaction, for it often happens that the heat generated in

the journal has melted the Babbitt metal so that it runs out of the boxes.

Ordinary brass, which is used in journal boxes, is often very uneven in texture, and thus causes heat to be generated.

Raw cowhide has been found to be much better than Babbitt metal, or ordinary brass for wearing surface in journal boxes.

The most homogeneous alloy of copper is phosphor bronze, which is excellent for journal boxes. Cast iron is also much better than ordinary brass, as far as heating is concerned.

The best remedy for cooling heated journals is to pour cold water on them, and in marine engines they have special arrangements for running a current of cold water around the journal boxes when heated. Flour of sulphur mixed with the lubricants is also used for cooling journals.

It is very difficult, if not impossible, to find any metal for journals and boxes which would not become heated under the transmission of sufficient power; but within the limit of ordinary practice, cast steel journals, well fitted in boxes of phosphor bronze or cast iron, are the best yet known.

The larger the area of the journal the less liable it should be to heat, but the contact area is proportionate to the diameter multiplied by the length of the journal, from which it appears that the longer the journal is, the less liable it is to heat, but such is not the case. Beyond a certain limit, long journals are very difficult, and sometimes, impossible to keep in proper contact in the boxes, particularly when the boxes are rigid, and they are therefore more liable to heat than those of the ordinary length, namely, one and a half diameters.

Whatever the proportion of length and diameter of a journal may be, and however well it may be fitted in the boxes, when made of puddled iron and subjected to heavy work, the heat generated projects, by expansion, some parts of the uneven iron more than others, by which, the whole load is thrown on a very small surface, which thus becomes overheated, and that heat is rapidly conducted to other parts, and finally throughout the whole journal. If not observed in time and cooled with water, the journal may become ruined.

New machinery, particularly steam engines, generally run hot in the journals at first, the degree of heat depending upon how well they are fitted; but by a prompt application of cool water while the engine is running, the wearing surfaces will gradually accommodate themselves to one another, and finally give less trouble.

The wearing surfaces can stand only a limited pressure per unit of area in contact, depending upon the nature of the materials; and when that limit is reached, namely, at the point of abrasion, the cutting in the journal commences.

Cone Pulley Diameters.

No. 3.

By J. F. Klein.

We present this matter once more to the readers of the AMERICAN MACHINIST in order that we may correct, as thoroughly as possible, the mistake made in illustrating the use of the tables published October 15th. The tables in the present issue cover a somewhat greater range than those already published, but are otherwise the same. The data of the following examples are the same as those contained in the AMERICAN MACHINIST for October 15th.

EXAMPLE 1. Suppose the centers of pulley shafts to be 60″ apart, and that the average difference between the adjacent steps is to be 2½″; also that each cone is to have six steps, the smallest having a diameter equal to 5″, which, in the present case, is equivalent to saying that the largest step is to have a diameter equal to 17½″. To obtain the remaining diameters we look in Table I. (corresponding to cone pulleys with six steps), under 60″ and opposite 2½″, and obtain the differences:

2.37 2.43 2.50 2.57 2.63

Each of these differences is *subtracted* from the *larger* diameter of the two adjacent steps to which it corresponds, thus:

17,50 = 1st step.

Diff. of 1st and 2d = 2.37

15.13 = 2d "

" 2d and 3d = 2.43

12.70 = 3d "

" 3d and 4th = 2.50

10.20 = 4th "

" 4th and 5th = 2.57

7.63 = 5th "

" 5th and 6th = 2.63

5.00 = 6th "

EXAMPLE 2. If we suppose the same conditions as in Example 1, with the exception that each cone is to have four steps instead of six, the largest diameter will, in this case, equal 12½″, and we may obtain the remaining diameters by omitting the end differences of the above example, and then subtracting the remaining differences as follows:

12.50=2d step.

Diff. of 2d and 3d= 2.43

10.07=3d "

" 3d and 4th= 2.50

7.57=4th "

" 4th and 5th= 2.57

5.00=5th "

The 2d, 3d, 4th, and 5th steps of the table correspond respectively to the 1st, 2d, 3d, and 4th steps of the cone, having but four steps. If the smallest diameter had not been assumed equal to 5″, we might have dropped a step at each end of the six-step cone of the preceding example, and employed the remaining four diameters, 15.13″, 12.70″, 10.20″ and 7.63″, for one four-step cone.

The present and the previous examples show that we can assume the size of the smallest step anything that we please, and, other things being equal, can make the required cones large or small.

EXAMPLE 3. Let distance apart of the centers=30″, the average difference between adjacent steps=2″, the diameter of the smallest step=4″, and the number of steps on each of the cones=5. The largest step will then equal 12′, and from Table II., under 30″ and opposite 2′, we obtain the differences

1.87 1.96 2.04 2.13

and then subtracting as before we get the required diameters

12″ 10.13″ 8.17″ 6.13″ 4″

EXAMPLE 4. Let the conditions be as in the preceding example, the cone pulley having, however, three steps instead of five, the largest diameter will then equal 8″; and by dropping the end differences and subtracting

8.00=2d step.

Diff. of 2d and 3d=1.96

6.04=3d "

" 3d and 4th=2.04

4.00=4th "

we get the diameters 8″, 6.04, and 4″, which correspond respectively to 2d, 3d, and 4th steps of the table, and to the 1st, 2d, and 3d steps of the three-step cone.

EXAMPLE 5. Let the distance apart of the centers be 60″, the average difference between the adjacent steps be 2⅛″, the smallest step 7″ and the number of steps = 5. The largest step will then be 7″ + (4×2⅛) = 15½ inches.

Now an inspection of table II. will show that it contains no horizontal lines corresponding to the average difference 2⅛ inches, we cannot, therefore, as heretofore, obtain the required differences directly, but must interpolate as follows: since 2⅛ inches is quarter way between 2 inches and 2¼ inches, the numbers corresponding to 2⅛ inches (for any given distance apart of the centers), will be quarter way between the numbers of the table corresponding to 2 inches and 2¼ inches.

I.—Table for Finding Cone Pulley Diameters

when the two pulleys are connected by an *open* belt, and are exactly *alike*. The numbers given in table are the differences between the diameters of the adjacent steps on either cone pulley, and can be employed when there are either Six or Four Steps on a Cone.

When there are *six* steps, the largest is the 1st, and the smallest the 6th step of the table.
When there are *four* steps, the largest is the 2d, and the smallest the 5th step of the table.

Average difference between the adjacent steps.	Adjacent steps whose difference is given in table.	Distance Between the Centers of Cone Pulleys.											
		10″	20″	30″	40″	50″	60″	70″	80″	90″	100″	120″	240″
1″	1st and 2d	0.87	0.94	0.96	0.97	0.98	0.98	0.98	0.98	0.99	0.99	0.99	1.00
	2d " 3d	0.94	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00	1.00
	3d " 4th	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	4th " 5th	1.06	1.03	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.00
	5th " 6th	1.13	1.06	1.04	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.00
1½″	1st and 2d	1.21	1.36	1.40	1.43	1.44	1.45	1.46	1.46	1.47	1.47	1.48	1.49
	2d " 3d	1.36	1.43	1.45	1.46	1.47	1.48	1.48	1.48	1.49	1.49	1.49	1.49
	3d " 4th	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
	4th " 5th	1.64	1.57	1.55	1.54	1.53	1.52	1.52	1.52	1.51	1.51	1.51	1.51
	5th " 6th	1.79	1.64	1.60	1.57	1.56	1.55	1.54	1.54	1.53	1.53	1.52	1.51
2″	1st and 2d	1.47	1.74	1.83	1.87	1.90	1.92	1.93	1.93	1.94	1.95	1.96	1.98
	2d " 3d	1.74	1.87	1.92	1.93	1.95	1.96	1.96	1.97	1.97	1.97	1.98	1.99
	3d " 4th	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	4th " 5th	2.26	2.13	2.08	2.07	2.05	2.04	2.04	2.03	2.03	2.03	2.02	2.01
	5th " 6th	2.53	2.26	2.17	2.13	2.10	2.08	2.07	2.07	2.06	2.05	2.04	2.02
2½″	1st and 2d	1.66	2.10	2.23	2.30	2.34	2.37	2.39	2.40	2.41	2.42	2.43	2.47
	2d " 3d	2.10	2.30	2.37	2.40	2.42	2.43	2.44	2.45	2.46	2.46	2.47	2.49
	3d " 4th	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	4th " 5th	2.90	2.70	2.63	2.60	2.58	2.57	2.56	2.55	2.54	2.54	2.53	2.51
	5th " 6th	3.34	2.90	2.77	2.70	2.66	2.63	2.61	2.60	2.59	2.58	2.57	2.53
3″	1st and 2d	1.76	2.42	2.62	2.71	2.77	2.81	2.84	2.86	2.87	2.88	2.90	2.95
	2d " 3d	2.42	2.71	2.81	2.86	2.88	2.90	2.92	2.93	2.94	2.94	2.95	2.98
	3d " 4th	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	4th " 5th	3.58	3.29	3.19	3.14	3.12	3.10	3.08	3.07	3.06	2.06	3.05	3.02
	5th " 6th	4.24	3.58	3.38	3.29	3.23	3.19	3.16	3.14	3.13	3.12	3.10	3.05
4″	1st and 2d		2.95	3.31	3.49	3.59	3.66	3.71	3.75	3.78	3.80	3.83	3.91
	2d " 3d	2.94	3.49	3.66	3.75	3.80	3.83	3.85	3.87	3.88	3.89	3.91	3.96
	3d " 4th	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	4th " 5th	5.06	4.51	4.34	4.25	4.20	4.17	4.15	4.13	4.12	4.11	4.09	4.04
	5th " 6th		5.05	4.69	4.51	4.41	4.34	4.29	4.25	4.22	4.20	4.17	4.09
5″	1st and 2d		3.33	3.92	4.20	4.36	4.47	4.55	4.60	4.64	4.68	4.74	4.87
	2d " 3d	3.31	4.19	4.47	4.60	4.68	4.74	4.77	4.80	4.82	4.84	4.86	4.93
	3d " 4th	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	4th " 5th	6.69	5.81	5.53	5.40	5.32	5.26	5.23	5.20	5.18	5.16	5.14	5.07
	5th " 6th		6.67	6.09	5.80	5.64	5.53	5.45	5.40	5.36	5.32	5.26	5.13
6″	1st and 2d		3.52	4.42	4.83	5.08	5.23	5.34	5.42	5.49	5.55	5.62	5.80
	2d " 3d		4.83	5.23	5.42	5.54	5.62	5.67	5.71	5.75	5.77	5.81	5.90
	3d " 4th		6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	4th " 5th		7.17	6.77	6.58	6.46	6.38	6.33	6.29	6.25	6.23	6.19	6.10
	5th " 6th		8.48	7.58	7.17	6.92	6.77	6.66	6.58	6.51	6.45	6.38	6.20

II.—Table for Finding Cone Pulley Diameters

when the two pulleys are connected by an *open* belt, and are exactly *alike*. The numbers given in table are the differences between the diameters of the adjacent steps on either cone pulley, and can be employed when there are either Five or Three Steps on a Cone.

Average difference between the adjacent steps.	Adjacent steps whose difference is given in table.	Distance Between the Centers of the Cone Pulleys.											
		10″	20″	30″	40″	50″	60″	70″	80″	90″	100″	120″	240″
1″	1st and 2d	0.90	0.95	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00
	2d " 3d	0.97	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00
	3d " 4th	1.03	1.02	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00	1.00	1.00
	4th " 5th	1.10	1.05	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.00
1½″	1st and 2d	1.28	1.39	1.43	1.45	1.46	1.46	1.47	1.47	1.48	1.48	1.48	1.49
	2d " 3d	1.43	1.46	1.48	1.48	1.48	1.49	1.49	1.49	1.49	1.49	1.49	1.49
	3d " 4th	1.57	1.54	1.52	1.52	1.52	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	4th " 5th	1.72	1.61	1.57	1.55	1.54	1.54	1.53	1.53	1.52	1.52	1.52	1.51
2″	1st and 2d	1.61	1.81	1.87	1.90	1.92	1.93	1.94	1.95	1.96	1.96	1.97	1.98
	2d " 3d	1.87	1.94	1.96	1.97	1.97	1.98	1.98	1.98	1.99	1.99	1.99	1.99
	3d " 4th	2.13	2.06	2.04	2.03	2.03	2.02	2.02	2.02	2.01	2.01	2.01	2.01
	4th " 5th	2.39	2.19	2.13	2.10	2.08	2.07	2.06	2.05	2.04	2.04	2.03	2.02
2½″	1st and 2d	1.89	2.20	2.30	2.35	2.38	2.40	2.41	2.42	2.43	2.44	2.45	2.47
	2d " 3d	2.30	2.40	2.43	2.45	2.46	2.47	2.47	2.47	2.48	2.48	2.48	2.49
	3d " 4th	2.70	2.60	2.57	2.55	2.54	2.53	2.53	2.53	2.52	2.52	2.52	2.51
	4th " 5th	3.11	2.80	2.70	2.65	2.62	2.60	2.59	2.58	2.57	2.56	2.55	2.53
3″	1st and 2d	2.10	2.57	2.71	2.78	2.83	2.86	2.87	2.89	2.90	2.91	2.93	2.96
	2d " 3d	2.71	2.86	2.90	2.93	2.94	2.95	2.96	2.96	2.97	2.97	2.98	2.99
	3d " 4th	3.29	3.14	3.10	3.07	3.06	3.05	3.04	3.04	3.03	3.03	3.02	3.01
	4th " 5th	3.90	3.43	3.29	3.22	3.17	3.14	3.13	3.11	3.10	3.09	3.07	3.04
4″	1st and 2d		3.22	3.49	3.62	3.69	3.75	3.78	3.81	3.83	3.84	3.87	3.94
	2d " 3d	3.48	3.74	3.83	3.87	3.90	3.91	3.92	3.94	3.94	3.95	3.96	3.98
	3d " 4th	4.52	4.26	4.17	4.13	4.10	4.09	4.08	4.06	4.06	4.05	4.04	4.02
	4th " 5th		4.78	4.51	4.38	4.31	4.25	4.22	4.19	4.17	4.16	4.13	4.06
5″	1st and 2d		3.77	4.20	4.40	4.52	4.60	4.66	4.71	4.73	4.76	4.80	4.90
	2d " 3d	4.19	4.60	4.73	4.80	4.84	4.87	4.89	4.90	4.91	4 92	4.93	4.96
	3d " 4th	5.81	5.40	5.27	5.20	5.16	5.13	5.11	5.10	5.09	5.08	5.07	5.04
	4th " 5th		6.23	5.80	5.60	5.48	5.40	5.34	5.29	5.27	5.24	5.20	5.10
6″	1st and 2d		4.21	4.83	5.13	5.31	5.42	5.51	5.57	5.62	5.66	5.71	5.86
	2d " 3d	4.82	5.42	5.62	5.71	5.77	5.81	5.83	5.86	5.87	5.88	5.90	5.95
	3d " 4th	7.18	6.58	6.38	6.29	6.23	6.19	6.17	6.14	6.13	6.12	6.10	6.05
	4th " 5th		7.79	7.17	6.87	6.69	6.58	6.49	6.43	6.38	6.34	9.29	6.14

Thus, in table II., we have under 60 inches,

and opposite 2½″:	2.40	2.47	2.53	2.60
" 2 "	1.93	1.98	2.02	2.07
	.47	.49	.51	.53

Dividing these differences by 4, we get:

.12 .12 .13 .13

to which we add,

1.93 1.98 2.02 2.07

and get for the differences corresponding to 2⅛ inches.

2.05 2.10 2.15 2.20

and subtracting as before,

15.50 = 1st step

diff. of 1st and 2d = 2.05

13.45 = 2d step

" 2d " 3d = 2.10

11.35 = 3d step

" 3d " 4th = 2-15

9.20 = 4th step

" 4th " 5th = 2.20

7.00 = 5th step

For hardening thin steel articles Dr. Hartman recommends: 4¾ quarts of train oil, 2 pounds of beef tallow, ¼ pound of beeswax, and 1 pound of rosin. The exact amount of rosin, however, is a matter of experiment, always bearing in mind that the greater the proportion of rosin the higher the temper. Another mixture recommended on the same authority, is 95 quarts of spermaceti oil, 20 pounds of tallow, 4½ quarts of neats-foot oil, 1 pound of pitch, and 3 pounds of rosin. The pitch and rosin are melted, the other ingredients added, and the whole heated until it will ignite if a blaze is brought in contact with it, when it is covered and allowed to cool.

A New Turret-Head Tool.

The utility of the turret-head or monitor lathe attachment has become generally known, and its use within the past few years comparatively common. With its revolving head adapted to receive a half dozen tools, each adjusted to the requirements of some special part in the round of operations to which a piece must be subjected, and each of which may be instantly brought into a position to perform its part, its advent, beyond question, marked a decided step forward in the line of machine tools.

The purpose of the manufacturer of the modest little tool herewith presented, is to furnish a cheap substitute for the expensive monitor attachment, or, more properly speaking, to furnish an inexpensive tool that may be used with the ordinary lathe for many of the purposes for which a turret-head lathe would be used; particularly by those —for instance—who do not have work enough of the character to guarantee the investment in a high-priced machine.

Of the engravings, Fig. 1 is an elevation showing the blank center *A*, the head with three tools in place, together with the set screws for holding them, and the latch at *E* and *F*, for locking the two parts of the head together; while Fig. 2 is a longitudinal section of the same.

As will be seen, this tool complete consists of a center *A*, which in all respects fits the spindle of the lathe in which it is to be used, precisely as the ordinary center does, while upon its outer end the small turret-head attachment is fastened.

This attachment consists essentially of two pieces, one of which, as previously stated, is rigidly fastened to the center, while the other is adapted to be revolved on the first-mentioned piece, being suitably guided and interlocked with it to that end. The revolving piece is pierced with six holes to receive as many different tools, and by the operation of the latch the two parts are instantly locked together, so as to bring either of the six tools in a position to do the particular part assigned to it.

It will be seen that the line of separation of the two pieces of the head is not in the same plane as the axis of the center to which they are attached, but is in such a degree inclined to it as to keep all the tools which may be in the head, except the one in position to be used, elevated and inclined above the horizontal axis of the lathe spindle. By this means the tools not in use are clear of the spindle and the end of the tail stock, which enables the head to be fitted so as to come close to the end of the spindle, and the spindle when in use to be kept well back in the tail stock, thus doing away with the liability to spring, from a long leverage or overhang.

This tool may be used in an engine or hand lathe, its substitution for the ordinary lathe center being made in the same time that one center may be changed for another; and, when used in a slide rest lathe, it interferes in no way with the use of the slide.

The uses which can be made of a tool of this character are too apparent for comment, and will readily suggest themselves to the mechanic, while its general construction will be understood from the engravings without further explanation.

These tools are made by T. R. Almond, 84 Pearl Street, Brooklyn, N. Y., who has applied for a patent on the device.

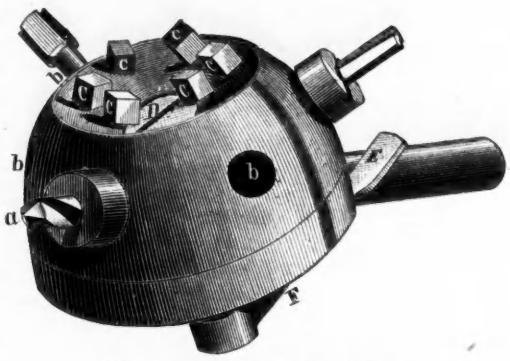


FIG. 1.—TURRET HEAD TOOL.

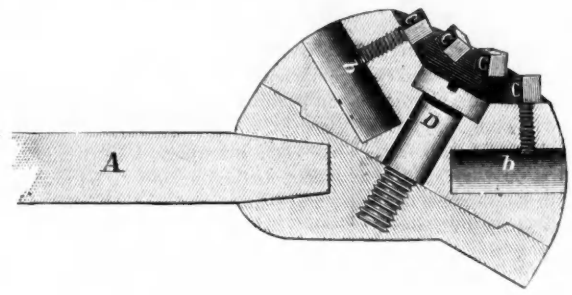


FIG. 2.—SECTION OF TURRET HEAD.

New Foot Power Treadle.

The drawings on this page represent a clutch pulley of novel construction, and a treadle arranged to act always in one direction, these parts being combined to secure continuous motion of the driven shaft. Fig. 1 is a side elevation of the machine; Fig. 2 an end view, with the frame in section; Fig. 3 a side view of the clutch pulley, with one side plate removed; and Fig. 4 a sectional view of the clutch on line *x x* of Fig. 3. Similar letters of reference indicate corresponding parts.

A is a frame of suitable form, carrying an upper cross shaft *a* and lower cross shaft *b*, sustained in suitable bearings. The shaft *a* is the driven shaft, and carries the clutch pulley *B* and fly wheel *c*. The treadle shaft *b* carries a large pulley *d* and smaller pulley *e*, both of which are fast. The treadle *f* is hung by one end to the frame of the machine. From the treadle a strap *g* passes to and around the pulley *e*, and from the pulley *d* two straps *h h*¹ pass to and around the clutch pulley *B*. These straps *h h*¹ are placed side by side, and are wound in opposite directions, so that they pass off at opposite sides. The ends of the straps are connected to the pulleys. The clutch pulley *B* is bored centrally for the shaft, and formed at the sides of the central aperture with tangential grooves *i*, that extend from end to end of the hub and open into the bore. In the grooves *i* are pins or rollers *k*, behind which are springs *l* that tend to force the rollers toward the shaft *a*. There are preferably three grooves *i*, and the rollers *k* are of such diameter that they will jam between the shaft and the tangent sides of the grooves. With this construction the pulley can turn freely on the shaft in one direction, and will clutch the shaft firmly when turned the reverse way. As shown, the pulley clutches when turned to the left, but that may be changed by simply reversing the pulley on the shaft. In operation, the treadle being pressed down, the strap *g* turns pulley *e* and shaft *b*, and the strap *h*, being thereby wound on pulley *d*, turns the clutch pulley *B* in the direction for clutching the shaft *a*. The shaft is consequently turned and continues to turn by momentum of the fly wheel during the return movement of the clutch. This movement of the strap *h* winds the strap *h*¹ on the clutch pulley, so that the reverse movement of the shaft *b* will unwind strap *h*¹, reverse the revolution of the clutch, and rewind strap *h*. The reversal of the movement is accomplished by a spring, or similar device. As shown, there is a spiral spring *m* on shaft *b* connected to the frame and to the pulley *d*. At the forward movement the spring is wound, and reverses the movement of the shaft by its action. The advantages of this device are claimed to be: First. There is no dead center; the shaft may be moved at any time and at any place, and *always* in the right direction. Second. A larger amount of power and a greater rate of speed can be obtained with half the labor required by a crank, or by any similar device. The power is applied at the closest proximity to the center of shaft, and is a *positive* motion. This power is particularly adapted to sewing machines, circular and jig saws, coffee mills, printing and other presses, blowers and lathes of all kinds.

The Mayo & Perry Clutch and Foot Power Manufacturing Company, Boston, Mass., has been formed to manufacture this device.

Fig.1

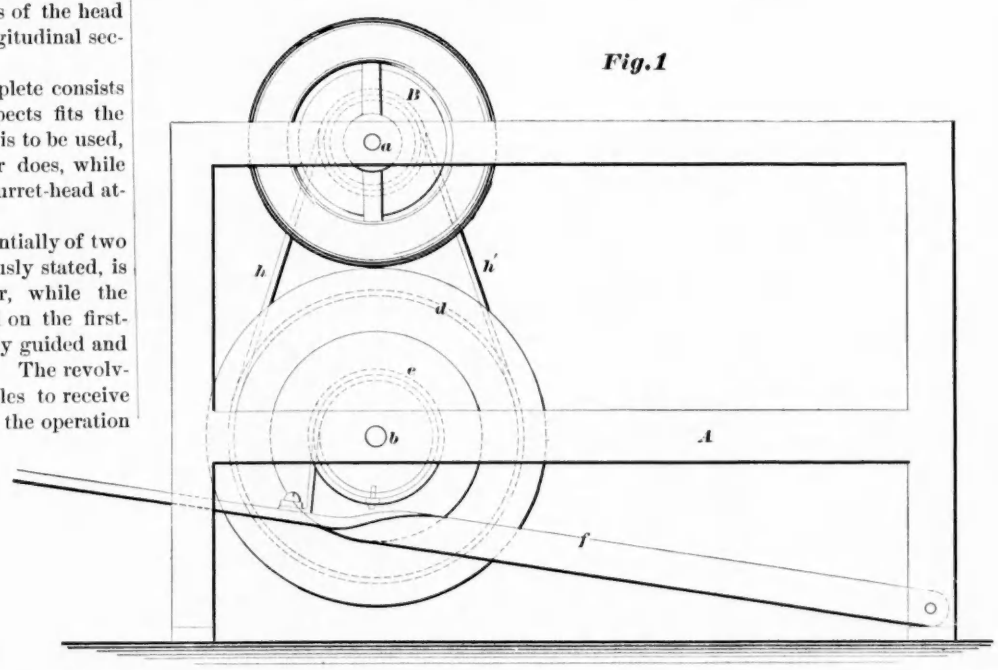


Fig.3

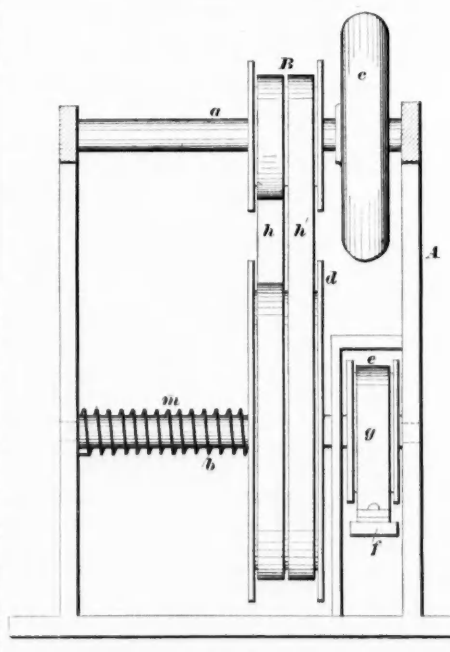
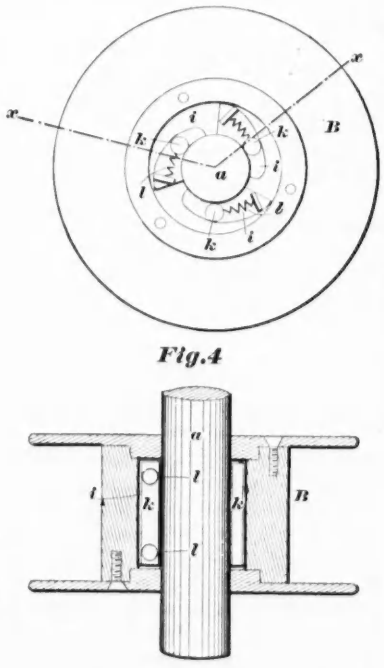


Fig.2

Fig.4



Efficiency of the Fontaine Locomotive.

During the past few weeks much has been said in the local papers in reference to Fontaine locomotive No. 2, which has been running at different times upon the N. Y. Division of the Pennsylvania Railroad. We have been watching the performances of this locomotive with great interest, but up to this time we must admit that it has come far short of the duty of the standard engines of the Pennsylvania Railroad. Several trips have been made from New York to Philadelphia by this locomotive, drawing empty cars, with which it was impossible to make the schedule time. Alterations have been made upon the locomotive, with no better results. The remarkable showing of Fontaine locomotive No. 1, in Canada, is explained in this way: The Baldwin locomotive, upon the same road, and with which the comparison was made, was either badly out of order, or was in the hands of a very extravagant engineer, for, by comparing its performance with the same class of locomotive upon the Pennsylvania Railroad, it was found to consume about double the fuel in running the same number of miles. It has also been found that the arrangement of levers for pressing the friction wheels together, instead of throwing additional weight upon the driving wheels, thereby increasing the adhesion by reason of a faulty construction, takes several hundred pounds weight off the driving wheels and throws it upon the truck.

From the time Fontaine locomotive No. 2 was placed upon the Pennsylvania Railroad, when inquiry was made concerning it, we were told that it was being made ready for a *trial trip*. But it makes a trip every few days, giving results which are not favorable for publication. We shall await the *trial trip* with considerable interest.

According to the Census report for 1880, there are 3,052 manufactories of carriages and wagons in the United States. New York State leads the list with 493, Pennsylvania follows with 296, and Ohio comes third, with 284. The greatest number of hands employed by all these establishments at any time during the year was 46,999, and the average wages for skilled mechanics in most States was about $2.00 a day. Only 14 of the establishments were idle, all the rest working on full time. Wyoming paid the highest average wages for mechanics, $4.50 a day; North Carolina and South Carolina paid the lowest, being $1.65 a day. In the last two States the average wages paid for ordinary laborers was $70 cents and 80 cents a day, respectively.

The whole number of manufactories of carriage and wagon materials in 1880 was 332, employing 6,677 hands. The highest average mechanics' wages paid, was, in Connecticut, $2.20, and the lowest, in Tennessee, $1.40. The total amount paid in wages was $2,230,408, and the value of the product $8,403,441.

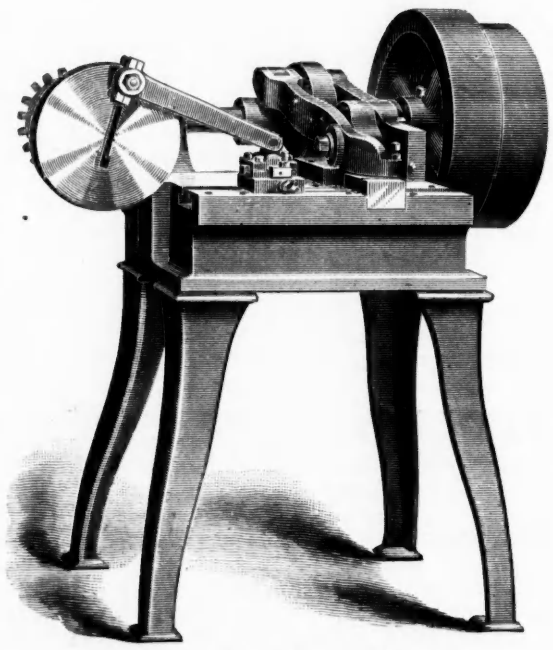
New Wire Straightening and Cutting Machines.

The accompanying engravings represent two new machines for straightening and cutting wire. They are manufactured by John Adt, 22 Artisan St., New Haven, Conn. In the Automatic Wire Cutting Machine, the wire from the coil is first drawn through a straightener, and passes in its progress to the cutting machine, where it is cut to the exact length desired with great rapidity. The gripping device which grips the wire, and by its operation pulls it through the straightener, is mounted on a slide, which is adapted to traverse back and forth by the operation of the pitman shown in the engraving. It will be seen that the rotating disc, to which this pitman is connected, is provided with a slot, by which its throw, and consequently the motion of the slide, can be regulated at will. This furnishes a ready means for adjusting the length to which the wire is to be cut. The wire, which is drawn forward to a distance determined by the position of the crank pin in the slot previously mentioned, is held in position by the first of the two levers shown in the engraving, while the second lever, which is provided with a suitably arranged cutter, cuts it off. The two levers just mentioned are operated by the motion of cams on the main shaft.

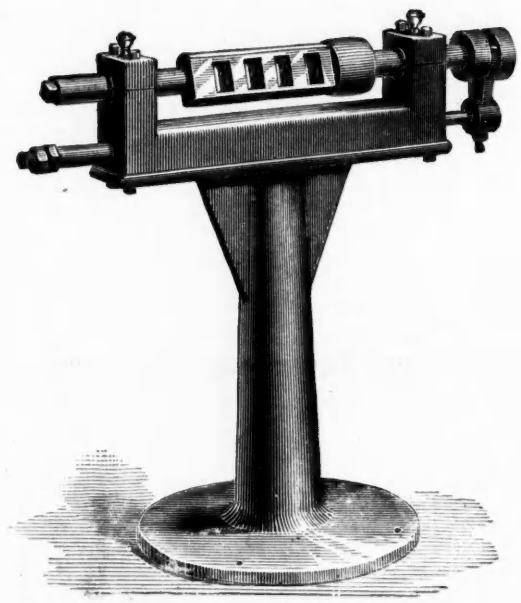
The construction of this machine is such as to adapt it to a great variety of sizes and lengths of wire.

The engraving of the Rotary Wire Straightener represents what is known as the five-die oscillating straightener. This machine is mounted on a stand, as shown; and in its operation the wire passes through the upper revolving mandrel, which is provided with dies. These dies are adjusted with set screws for the particular size of wire to be straightened; and, when the adjustment is properly made, the wire from the coil being fed through the machine, comes out straight.

To adapt this machine to be used with the cutting machine previously described, the device which is shown in the engraving is provided, the effect of which is to permit a longitudinal motion of the mandrel to prevent injury to the wire when the feed is stopped.



AUTOMATIC WIRE CUTTING MACHINE.



ROTARY OSCILLATING WIRE STRAIGHTENER.

A New Method of Keeping Mechanical Drawings.

BY CHAS. T. PORTER.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The system of keeping drawings now in use at the works of the Southwark Foundry and Machine Company, in Philadelphia, has been found so satisfactory in its operation that it seems worthy of being communicated to the profession.

The method in common use, and which may be called the natural method, is to devote a separate drawer to the drawings of each machine, or of each group or class of machines. The fundamental idea of this system, and its only one, is, keeping together all drawings relating to the same subject matter.

Every draughtsman is acquainted with its practical working. It is necessary to make the drawing of a machine, and of its separate parts on sheets of different sizes. The drawer in which all these are kept must be large enough to accommodate the largest sheets. The smaller ones cannot be located in the drawer, and as these find their way to one side or to the back, and several of the smallest lie side by side in one course, any arrangement of the sheets in the drawer is out of the question.

The operation of finding a drawing consists in turning the contents of the drawer all up until it is discovered. In this way the smaller sheets get out of sight or doubled up, and the larger ones are torn. No amount of care can prevent confusion.

Various plans have been adopted in different establishments intended to remedy this state of things, but it is believed that none has been hit upon so convenient, in all respects, as the one now to be presented.

The idea of keeping together drawings relating to the same machine, or of classifying them according to subjects in any way, is entirely abandoned, and in place of these is substituted the plan of keeping together all drawings that are made, on sheets of the same size, without regard to the subject of them.

Nine sizes of sheets were settled upon, as sufficient to meet our requirements, and on a sheet that will trim to one of these sizes, every drawing must be made. They are distinguished by the first nine letters of the alphabet. Size A is the antiquarian sheet trimmed, and the smaller sizes will cut from this sheet, without waste, as follows:

A, 51″ × 30″; B, 37″ × 30″; C, 25″ × 30″; D, 17″ × 30″; E, 12½″ × 30″; F, 8½″ × 30″; G, 17″ × 15″; H, 8½″ × 15″; I, 14″ × 25″.

The drawers for the different sizes are made 1 inch longer and wider than the sheets they are to contain, and are lettered as above. Those of the same size, after the first one, are distinguished by a numeral prefixed to the letter. The back part of each drawer is covered for a width of from six to ten inches, to prevent drawings, and especially tracings, from slipping over at the back.

The introduction of the blue-printing process has quite revolutionized the drawing office, so far at least as we are concerned. Our drawings are studies, left in pencil. When we can find nothing more to alter, tracings are made on cloth. These become our originals, and are kept in a fire-proof vault. This system is found admirably adapted to the plan of making a separate drawing for each piece. The whole combined drawing is not generally traced, but the separate pieces are picked out from it. All our working copies are blue prints.

Each drawer contains 50 tracings. They are 2½ inches deep, which is enough to hold several times as many, but this number is quite all that it is convenient to keep together. We would recommend for these shallower drawers.

Each drawing is marked in stencil in the lower right hand corner, and also with inverted plates in the upper left hand corner, with the letter and number of the drawer, and its own number in the drawer, as, for example, 3*F*—31; so that whichever way the sheet is put in the drawer, this appears at the front right hand corner. The drawings in each drawer are numbered separately, 50 being thus the highest number used.

For reference we depend on our indices. Each tracing when completed is entered under its letter in the numerical index, and is given the next consecutive number, and laid in its place.

From this index the title and the number are copied into other indices, under as many different headings as possible.

Thus all the drawings of any engine, or tool, or machine whatever, become assembled by their titles under the heading of such particular engine or tool or machine. So also the drawings of any particular part, of all sizes and styles, become assembled by their titles under the name of such piece. However numerous the drawings, and however great the variety of their subjects, the location of any one is, by this means, found as readily as a word in a dictionary. The stencil marks copy, of course, on the blue prints, and these, when not in use, are kept in the same manner as the tracings, except that only twenty-five are placed in one drawer.

We employ printed classified lists of the separate pieces constituting every steam engine, the manufacture of which is the sole business of these works, and on these, against the name of every piece, is given the drawer and number of the drawing on which it is represented. The office copies of these lists afford an additional mode of reference, and a very convenient one, used in practice almost exclusively. The foreman sends for the prints by the stencil marks, and these are thus got directly without reference to any index. They are charged in the same way, and reference to the numerical index gives the title of any missing print.

We find the different sizes to be used quite unequal. The method of making a separate tracing of each piece, which we carry to a great extent, causes the smaller sizes to multiply quite rapidly. We are marking our patterns with the stencil of the drawing of the same piece; and also, gauges, templets and jigs.

It is found best to permit the sheets to be put away by one person only, who also writes up the indices, which are kept in the fire-proof.

We were ourselves surprised at the saving of room which this system has effected. Probably less than one-fourth the space is occupied that the same drawings would require, if classified according to subjects.

The system is completely elastic. Work of the most diverse character might be undertaken every day, and the drawings of each article, whether few or many, would find places ready to receive them.

"It is one of the curious things of our day," says the Providence *Press*, "that there is no decently accurate gas-meter in general use in this country. If some public-spirited man would offer three or four large prizes for an accurate meter, inventors would turn their attention to it; but as long as the gas companies are satisfied with a slipshod meter, and there is no combination of consumers to procure a better one, so long we shall go on paying for 500 feet of gas the price of 1,000 feet."

Tapping out and Stopping up Cupolas.

BY THOMAS D. WEST.

There is nothing that will at times cause more excitement in a foundry than the tapping out and stopping up of the cupola, and sometimes the situation is more serious than comical. The comical part is to see the melter, when the cupola is nearly or quite full of iron, tapping out into two of three small ladles, and when he goes to stop up the clay falls off the bod stick or gets washed away. The iron flows over the ladle, and a spark finds lodging down the man's back that is holding it, and he lets go the ladle to dispossess the lodger. The foreman, who is standing by a large casting being poured, yells out for the cupola to be stopped up; the melter gets excited, runs the bod stick without any clay on it into the running iron, the sparks fly and the iron runs around his feet. He thinks of his home or family, and gets out of it as soon as he can. The foreman, thinking the situation is getting serious, runs from the riser he is watching to go to the cupola, and when half way there, he hears yells for water and sand, and looking back, he sees the cope strained and iron running out; at which point, if he is a man that swears, he will exhaust the whole vocabulary in a very short time. His orders to stop the blast; get water; go to the fire alarm; are no sooner issued to some trembling being than he hears the moulder cry out for more iron, and looks towards the cupola, at which moment a sight of his face when he sees the cupola empty and standing in a pool of boiling iron, would never be forgotten.

Such occurrences as these are frequent. I have seen men burned, castings lost, and the shop in great danger of being burned through excitement around a cupola. Sometimes it will be caused by the iron not being carried away fast enough, but in most cases it is the melter's fault. Go into almost any foundry and you will see the melter running his tapping bar into the tapping hole, as shown (in cut) at *D*. A stranger seeing him would think that he was trying to knock or push in the front breast.

The position of the tapping bar as shown at *X* is, I think, a more scientific one, for instead of trying to ram the clay into the cupola, the bar should be held so as to dig it out, or tear it away at the outside edges of the hole, when the pressure of the melted iron will push out the center. In tapping out this way you are always digging out the old stopping, and keeping a clean hole, and doing it with less labor, sledge hammering, and burning away the tapping bars, than in any other way I know of.

I have seen melters have their tapping holes, before a heat was through, bunged out 4″ or 5″, and every time they tapped out they would have a man or two striking or knocking the bar into the breast with heavy sledge hammers, and when in it would take four or five men to pull it out.

Of course, there is sometimes iron and scrap used that will make a deal of slag, and it is hard work to keep a breast or tapping hole clean, and melters are often exhausted in trying to do so. If they would only once adopt the plan here described, they would be astonished at the ease with which they could do their tapping.

In tapping out a cupola for the first ladle, there is often trouble on account of the iron not melting as fast as it ought to, or as fast as it will after a few minutes. The iron, especially if hard, chills in the hole, and when tapping out I have often seen the whole

breast knocked in to get the iron out. To remedy this, take a one inch round core 4″ or 5″ long, made with plenty of sea coal or blacking, and when the iron is melting at a fair stream, take the core and push it into the hole, stop over it, and when you take out for the first ladle you will have no trouble.

There is another thing a great many melters have a habit of doing when stopping up a cupola. That is, they will push the stopping against the running stream to get the hole stopped up, which always causes a splatter, and sometimes washes the stopping off the stick; whereas, if they would hold the stopping above the stream, and when near the hole push it down on a slant, they would not be so liable to burn some one, let the ladles flow over, or worse yet, let all the iron run out on the floor, which often results in large loss.

The mixtures of stopping have often a deal to do with accidents and trouble. About the best stopping for ordinary purposes is new moulding sand dampened with clay wash. This will not make the iron fly, and will tap out easy. If clay is used, it is a good thing to mix in some horse manure or sea coal. This will keep the clay from baking so hard, and make it tap easy.

Instead of having the bod sticks all wood, the cut *B* shows an iron nipple made to fit on the end of the wooden stick. This will save sticks, and should the stopping fall or wash off the iron, it will not fly so much. At *H* is shown a gouge-shaped end of a steel tapping bar, which is very handy.

The stand shown is a rigging, that I made one day in open sand after the blast went on. The top plate was cast first, and four half inch round rods cast in it, and when set enough turned up-side down and the rods cast into the bottom plate. In the top there is a pocket, cast for holding the wrought iron arms *A A*, which were made of ¼″ iron, with a shoulder to keep them from dropping down. When not in use, they could be reversed or taken out of the way. On the top *P* is a box for holding the stopping, and underneath is kept a pail of water for dipping the bars into. The arms *A A*, form a rest for holding the tapping bars and stopping sticks. The stand complete does not weigh over 75 pounds, and I find it handier than using barrels, boxes, or things commonly used for such purposes.

LETTERS FROM PRACTICAL MEN.

A New Reamer—Short Belts.

Editor American Machinist:

Enclosed you will find sketch of a reamer. The sketch represents a 1.5″ reamer. It has a groove dovetailed about two decimeters long, and a single steel cutter inserted. In front of the cutter is a recess to favor the chips. *B* is the steel cutter, *L* the recess on a cross section at *B L*. The writer could never use this reamer with any degree of success, yet it was in an Ohio shop claiming to do good work. Will some of the "Practical men" tell us if it is used anywhere successfully? This same shop has a large lathe with countershaft about 30″ from line shaft. Just imagine these short belts, cotton duck at that! I saw the man running the lathe put these belts on four times in ten minutes, and still they would not pull.

OHIO.

Ocean Steamers for Passengers.

Editor American Machinist:

Is it not about time that there was a line of ocean steamers built and run exclusively for passengers? Why should the traveling public on the ocean be compelled to risk their lives on overloaded freight steamers? Why not as well make all our railroad trains partly freight trains? Some say you must have ballast. Why build the steamer so as to require ballast? Build her for passengers and not for freight, and you would not require ballast. Place the boilers forward and your engine aft, giving the entire midships for saloons and staterooms, and the whole steamer for the passengers' accommodation, and not for freight.

Geneva, N. Y. W. B. DUNNING.

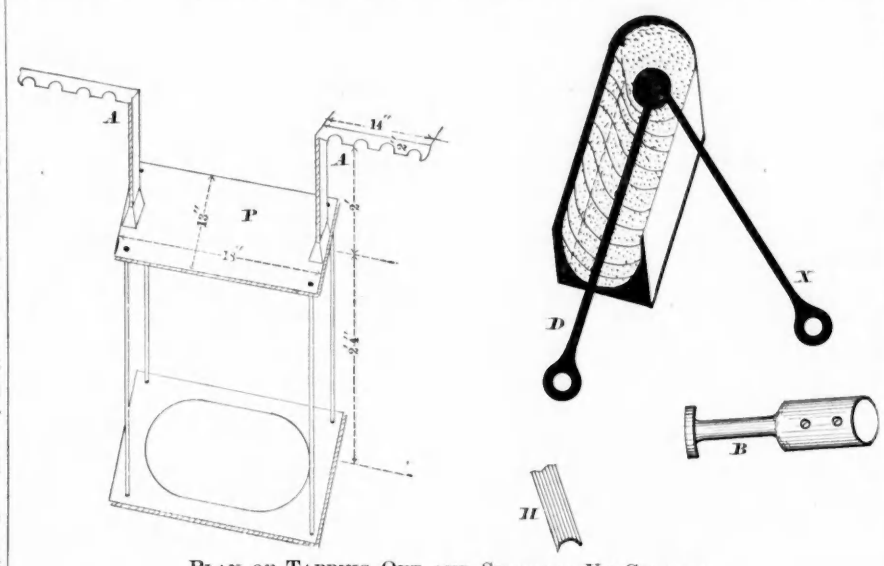
Iron Foundry Economies.

Editor American Machinist:

In your issue dated Nov. 5th, you have an article wherein is the question: "Is it better to buy castings, or make them for yourself?" Your peroration in that aforesaid article reminded me of a country boy's opinion, who, when urged to go after huckleberries, claimed it was "cheaper to buy them berries than for anybody to pick them."

I have yet to see or hear of that foundry where the castings were not costing too much.

The foundrymen are constantly being informed from the most reliable quarter that farther on or "over yonder" castings are produced from 10 to 50 per cent. less for labor than in his shop.



PLAN OF TAPPING OUT AND STOPPING UP CUPOLAS.

Now, Mr. Editor, if that place has been found where they have reached the lowest possible cost, and it is steadily maintained, please tell us of it. Don't keep it quiet. Tell us also how it is done. Tell about the quality of the work, and kind, fixtures, fuel, stock, lumber, cost of labor, and cost of living at that place; also, how near perfection the castings must be to finish up sound in the machine shop, cores or no cores, dry loam, or green sand; if it requires skilled or indifferent workmen, with or without cheap help; also, if a large part of machine shop work is expected to be performed in the foundry, etc., etc., etc.

People who have castings made, and who do not own foundries, are never happy about their cost. I have known such customers. They would have patterns in every shop within reach, and would be eternally hammering down the price.

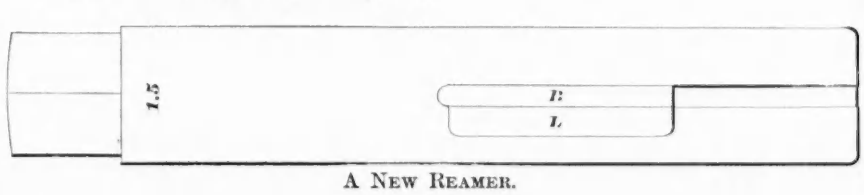
I know one of these "*get-'em-for-less*" chaps, who got so disgusted with the exorbitant prices of his castings that he started a foundry. The knowledge he soon acquired was how to charge higher and how to fight for prices higher than any one else.

There are manufacturing concerns that start up a foundry in connection with their other departments, who seem for the first two or three years to regard the foundry as a play house. Patterns are made and brought in that rival in intricacy a Chinese puzzle—as full of cores as a shad is full of bones. The mould has the appearance of a nursery man's sample box of grape vine cuttings, when it is ready to be closed. When the casting is cleaned it resembles a worm-eaten pile of an old wharf. At this time it is discovered that it will not do. There was no certainty about it in the beginning, as it was only an experiment of much doubt. Frequently a moulder is started on a job that requires four castings from the pattern. Cores are made in advance, and one or two castings are made. In comes a high-pressure job, which has to be done without fail. Job No. 1 is set aside. Another flask is brought in—new rig way through—to make this indispensable job. After it is cast it is discovered that the boring mill has been broken down for two or three days, and can't be repaired under a week, and this casting cannot be finished until then. In the meantime, the cores belonging to job No. 1, from frequent handling, have to be made over. Many pieces have cores that come, like Hamlet's ghost, in such questionable shape that you cannot refrain from speaking ofttimes more emphatically than polite, especially if they sit horizontally, with a print half an inch long. After all the foregoing complications, absence of forethought and wasteful experimenting, it is solemnly rehearsed to the foreman of that foundry that "up in the town of *anyhow-to-get-it*, where every one has a cow, two or three pigs and a ten-acre lot, they are turning out sash weights and slide valve engine castings 20 per cent. less than ours cost." This valuable information is given to him as often as once a month, frequently twice.

Now, Mr. Editor, if you will bear with me a short time longer, I wish to ask these few questions: Are there not less failures of foundries, as a business, than of any or all of the other branches of iron manufacturing? Have you ever known of an instance of an iron manufacturing company failure that was caused by a foundry being a part of the business? If so, was it not on account of dissipation or lamentable ignorance all around the works, and in the foundry particularly?

SAND POUNDER.

Philadelphia, Pa.



A NEW REAMER.

How to Help Apprentices.

Editor American Machinist:

An article on "Shop Experience" with boys, which has appeared in the AMERICAN MACHINIST, makes me feel like saying something about the matter. I have had considerable experience with boys in the past ten years—they as machinist apprentices, I as foreman. I don't know that I have had any remarkable boys, or that I have met with any marked success, but this I can say, and say it after due consideration, that if I had all those boys, good, bad and indifferent together, I would not exchange them for any other lot of men to be found. Of course there are reasons for this which are patent to everybody, but the conclusion is there, and I have arrived at it through judgment, and not through prejudice. Were you to ask me how I got along with them, I would frankly answer you the same as I have always answered them, when they have questioned me beyond my ken, that I don't know. The biggest fools I meet with are the men that pretend to know everything, and nobody understands this better than the average apprentice. However, there are some things I do know from observation, as well as from experience. One of these is that no man can be successful with boys or men who does not command their respect. They may fear him, they may hate him, they may even love him, but if they do not *respect* him he is a failure. Now about the case referred to, I cannot say that I admire the position taken by its two prominent characters, George and the writer. Of course George's position is involuntary, and he seems to be one of the goody-goody sort, but the position taken by the writer is wrong—not in taking the thoughtful boy from snagging castings and giving him a chance to learn a trade—not wrong in the main, but spoilt in the making. That bit of experience is ahead of anything I ever had. It must have been interesting. I can imagine the tears on the face of one apprentice, and a grin on the faces of the others. I should not wonder if that best foreman had business in some other part of the establishment about that time, and, by the way, I would like to meet that foreman, for I should not wonder if we have had some experience in common. But seriously let us consider this case. The writer seems to have dealt very gently with tearful George. Why not? He paid for the broken tool himself. What had George done in this matter? Broken a planer, and why? Simply because he was put to running a machine which he was not competent to run, but also was not competent to try to run.

The writer says he (George) was put on a small lathe first, because he did not think it policy to put a valuable apprentice to wiping grease, cutting bolts or running a drill press. Well, perhaps not, but I believe that clean, properly-threaded bolts in round holes are essential to a mechanical job, and I know that a man who can't do this (and there are lots of them) is not a machinist. As for wiping grease, I believe that one of the first things a boy should learn is, that labor is honorable, and that grit is essential to success. Wiping grease is honorable, and it takes grit to do it. I might give a bit of experience on this point, but forbear. An Apprentice's time too valuable to learn to run a drill press! Oh, shade of what's his name (I mean the patron saint of our trade)! too precious to learn to cut bolts!

I once knew several men, (I was going to say machinists) who were sent to the shop at night to do some work. In the course of the night they wanted a rough bolt threaded, and although there was a Sellers bolt cutter there, to save their necks not one of them that could do it. No; George's time was so valuable that he was not allowed to do these things and get used to machines, and so he was put by the writer, in spite of the remonstrance of confessedly the best foreman of the establishment, to running a planer—grammar before the alphabet. The natural result was a smash up, a bit of dear experience surely. Although the article does not state positively, yet it is evident that George was pushed far beyond the *ordinary* boys of the shop—a bad policy to pursue. Oh, says some one, that's the kind of man: you are one of the regular routine chaps, first month wiping grease, second, the bolt cutter, and so on. I do say never push a boy. Let him push himself. Urge him to do this by every means in your power. Let him know that his advancement depends entirely upon himself. Teach him self-reliance (not conceit). Make him responsible when he is fitted for it. Lay the foundation broad, deep and solid, and then let him climb.

You can't teach a boy to be a mechanic. You may teach him to cut bolts and drill holes after a fashion, but judgment and skill are from the boy himself. There is another matter in the article I would like to refer to, and may in the future; and that is, the position which the foreman occupied; but for the present must close.

FOREMAN.

Sunbury, Penn.

A cubic foot of cast iron weighs 450½, and of wrought iron 482½ pounds.

An Improved Method of Screw Propulsion.

BY JOHN B. ROOT.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

In the summer of 1879, I determined to build a small pleasure boat for my own use, with the view of demonstrating the value of the double hull principle of construction, which had to my mind advantages, as to the room, stability, &c.

I built a boat having two hulls 30 feet long, placed 8 feet apart in the clear, and decked over from hull to hull.

The propelling machinery was placed in the center; the engine crank revolved in a horizontal plane; the shaft going down through the deck, and driving a horizontal propeller-shaft by means of miter gears working below the water.

The boat answered my expectations, but the noise produced by the gears was annoying, and I decided to dispense with them, and by inclining the shaft downward and backward to work the screw direct from the engine.

I expected a loss of economy in so doing but preferred that to the noise.

In carrying out the change, I began to figure up the loss that would be encountered, and was surprised to find that I could not only obviate the loss, but as I then thought could realize a positive gain.

This led to a series of experiments during the last two years, which, by their results, have convinced me of the entire soundness of my theory.

My object in writing this paper is to promulgate what I consider to be valuable discoveries in the art of screw propulsion, and to induce others to invest money in a more thorough experimental demonstration of the principles involved, and their application to useful purposes.

I have not attempted to give exact figures, but have endeavored to set forth the principles involved, and their mode of application in producing the results I have obtained.

I claim to have discovered an improved method of applying screw propellers to vessels with the following advantages:

1st. Obtaining the same or greater effect upon the vessel by the use of a very much less angle of blade or pitch, by which a great part of the loss from side action or slip is obviated and the propelling power economized.

2nd. The resistance of the vessel is diminished by the lifting action of the screw, lessening the displacement.

To get a clear understanding of the advantages of my improvement, it is necessary to know how great is the loss by the present method and how it occurs. The essential points are:

1st. The requisite thrust upon the vessel.

2nd. The power required to produce the thrust.

Figure 1 shows a screw of an ordinary form, with a pitch of one and one-half diameters, and a horizontal axis, which, by its action, pushes the water directly astern causing a forward thrust upon the vessel.

Figure 2, shows a screw having about one-half the pitch of Fig. 1, and double the area of disc with its axis inclined at an angle of 60 degrees from the horizon, and acting to propel the vessel by pushing the water downward and backward.

The thrust of the screw being at an angle of 60° from the line of movement of the vessel, there is required double the force of thrust to produce the same forward push upon the vessel that would be required if exerted in a line with the movement of the vessel. This increase of thrust is provided by enlarging the diameter of the screw, until its disc area is sufficient to give the required thrust without excessive slip, when it will give the same forward push upon the vessel as Fig. 1, which has double the pitch and one-half the disc area.

I will compare the operation and effect of the two methods, and, in doing so, will assume that a screw by its action sends through its disc, in a line with its axis, a stream of water of the same diameter as the screw, at a velocity equal to the pitch of the screw less the velocity of the vessel. That is: at each revolution, the water will be moved a distance equal to the difference between the pitch of the screw and the velocity of approach of the water to the screw. Whether this is strictly true or not will make no difference for the purposes of comparison. In comparing the operation of the screws shown in figures 1 and 2, it is intended that they shall propel the vessel the same distance with the same number of revolutions; Fig. 2, giving double the thrust of Fig. 1, with the same or less power applied.

In Fig. 1, the motion of the water through the screw disc is in the same direction that the pitch of the blades act. The blades are acting upon water that has entered the screw with a velocity less than that with which it is discharged from the screw astern.

To illustrate, we will suppose a vessel with screw, Fig. 1, to be going through the water at a velocity of 10 feet per second and that the velocity of pitch is 12 feet per second; it is evident, that there would be imparted a velocity to the water of 2 feet per second. The difference between the velocity of approach (10 feet) and the velocity of pitch (12 feet) being 2 feet per second, this is the motion given to the water astern.

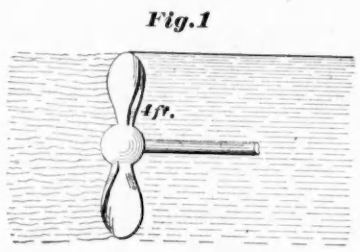


Fig. 1

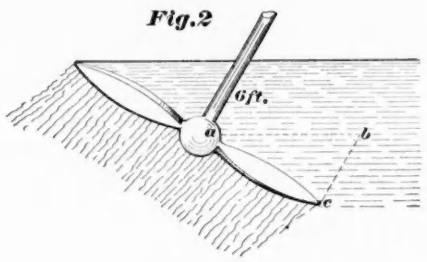


Fig. 2

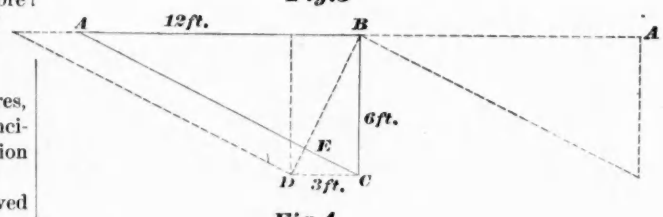


Fig. 3

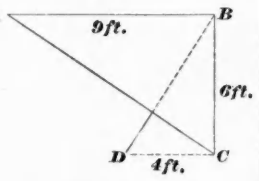


Fig. 5

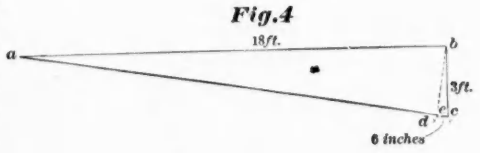


Fig. 4

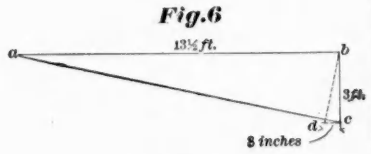


Fig. 6

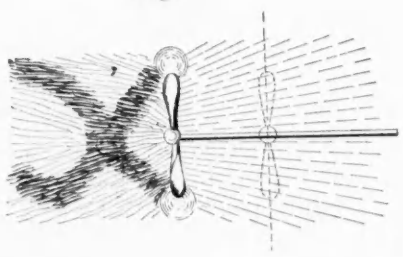


Fig. 9

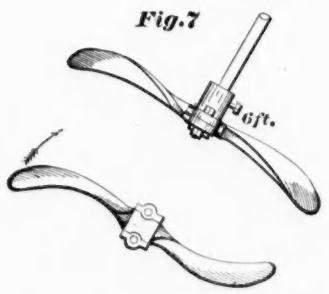


Fig. 7

This velocity of 2 feet per second is given to the water as it leaves the screw disc.

The after side of the disc pushes the water back, and the water in front follows to take its place in exactly the same manner that the water follows the piston of a pump. The pressure is enough greater on the after side of the disc, than on the forward side, to furnish the requisite force, to give the water passing through the screw its velocity.

As the screw revolves each blade impinges upon the water that has been put in motion by the preceding blade. If the velocity at the point of impingement given to it by the suction of the preceding blade were 1 foot per second, there would remain only 1 foot per second to be imparted to produce the velocity of two feet per second; one foot per second being imparted by the screw and the same due to momentum acquired before entering the serew.

If the screw were moved sidewise through the water in a line at right angles to its axis, the blades would strike or impinge upon water that had not been put in motion by the preceding blade, and there would be more velocity to be imparted by each blade, and consequently a greater thrust.

To bring out this point more clearly, we will suppose a screw were working in a circular channel, as shown in Fig. 8. The water would be put in motion around the circle and would return to the screw with the same velocity with which it left it. After the *inertia* of the water had been overcome, there would be no power required to keep it in motion, except to overcome the friction of the channel, and there would be no thrust given by the screw except that required to overcome the friction, and the velocity would remain constant from the first starting of the screw. But, in open water, the case is different; the velocity given to the water is dissipated in the mass of surrounding water, and the screw has constantly to put new water in motion from a state of rest, or increase the velocity of that which is in motion; hence the pressure of the screw, and its thrust upon the vessel.

It is only as it gives or adds motion to the water passing through it, that the screw gets the requisite resistance to propel the vessel.

It is necessary that each blade, as it revolves, should strike far enough ahead of the preceding one to get hold of water that has less than the maximum or pitch velocity.

Figure 9 is intended to show the increase of the velocity as the water approaches the disc, caused by the suction of the screw, and its decrease after it leaves it. The suction of the screw will bring the water towards it in a convergent stream, the velocity of which will increase as its area diminishes, until it reaches the screw disc, when it will have its maximum velocity, as it is discharged from the after edge of the blade. The leading edge of the next blade will have its path far enough ahead of its predecessor to get hold of water that has less than the maximum velocity.

If, without changing the pitch, there was substituted for an ordinary two bladed screw one having a great number of very narrow thin blades, the thrust would be found to be very greatly diminished, for the reason that the difference in velocity of the water between entering and leaving the blades, would be very slight, and yet the water would leave the screw at the same velocity as with the two-bladed screw.

The result would be similar to that of the circular channel (Fig. 8), inasmuch as the blades would act only upon water having nearly its maximum velocity, *which once imparted by the first starting of the screw would remain constant*, so long as sufficient power was employed to overcome the friction, or the molecular resistance of the water. The water leaving the screw disc with its maximum velocity, by its momentum draws other water through the disc from the front, to take its place.

(I am not aware that this peculiar action of the screw propeller is fully understood.

The rules for proportioning the pitch to the number of blades given in Mr. Burgh's book, would indicate that it was not understood. The rule given is in substance this:

"The more blades the less pitch, or two blades one and one-half diameters, three blades one and one-third diameters, four blades one diameter."

Now as either reducing the pitch or increasing the number of blades, causes them to strike or impinge upon the water nearer the point of maximum velocity, it seems to me that this rule is essentially wrong and shows that the matter was not understood.

I am not aware that any explanation or allusion to it has before been published. The matter was forced upon my mind by unlooked-for experimental results which led to further investigation.)

The pressure of the screw disc upon the water, and its consequent thrust upon the vessel is, according to Rankine, "the product of three factors: the mass of a cubic foot of water; the number of cubic feet of water acted on in a second; and the velocity in feet per second impressed upon that water by the propeller."

The mass of a cubic foot of water being taken as 2, being the weight of a cubic foot of sea water (64 lbs.) divided by the accelerating effect of gravity in a second (32 feet).

For instance, if the vessel has a speed of 10 feet per second, and the pitch velocity was 12 feet per second, the area of the screw disc being 12 feet, the reaction or thrust would be found thus:

(Mass 2) × (No. feet acted on 144) × (velocity impressed upon that water 2 feet per second) = 576 lbs., but if, as I believe, a part of the velocity impressed upon the water by the screw is constant from the first starting of the screw, then the thrust of 576 lbs. is too great.

The "Pitch Velocity" may be resolved into its two components, the direct velocity and the lateral or transverse velocity.

The power applied to the vessel by the screw is the thrust × by the direct velocity. The power that is required in excess of that shown by multiplying the thrust by the direct velocity is a loss, and comes from three causes.

1. The thickness of the blades offer resistance.

2. The surface of the blades gives frictional resistance.

3. The pitch or angle of the blades causes the water acted upon by them to be moved or discharged from the screw disc sidewise or at an angle to the axis, instead of in a line with, or parallel to, the axis of the screw.

It is necessary in considering the action of the screw propeller, to discard the idea of a screw turning in a solid nut, which is a positive, mechanical movement, the turning of the screw giving in all cases an exact equivalent of progressive motion. But a screw working in water is an entirely different thing, and the only way to estimate its reactionary effect in any one direction is to compute the weight of water and its velocity in an opposite direction.

A certain reactionary force can be got more economically by moving a large amount of water at a low velocity than by a small amount at a high velocity, if the resistance of thickness and surface of blade is not increased sufficiently to counteract the gain.

By applying the foregoing principles to the action of the inclined screw, shown in Fig. 2, its comparative effect can be estimated. In Fig. 2 it will be observed that the water enters the screw, as the vessel moves ahead, at an angle of 60° from the axial line of the screw, and not parallel with the axis, as in Fig. 1; and consequently, when the screw and the vessel are moving through the water at the same velocity as in Fig. 1, the water entering the screw approaches it, with only one-half the velocity. By reference to Fig. 2, it will be seen that the vessel and screw must move the distance from *a* to *b*, while the water approaches towards the screw the distance from *b* to *c*.

The velocity of approach of the water towards the screw is only one-half that with which the screw passes through the water as the vessel goes ahead. The result necessarily follows that the blades of the screw act constantly upon water, that, when it enters the influence of the screw, has only half the velocity of approach that it would have if it entered on a line parallel with the axis of the screw.

For instance, as in the former case, the vessel is moving through the water ten feet per second, the velocity of approach is five feet, the velocity of pitch six feet, leaving a velocity of one foot per second to be imparted to the water. But, as the screw progresses partly sidewise through the water, the blades are acting upon water that has not been put in motion towards the screw by the action of the preceding blades. This leaves a greater proportional velocity to be imparted by the blades to the water, even though its velocity on leaving the screw disc be less.

Figs. 10 and 11 show the path of the blades of the inclined screw through the water.

It will be seen that the path looked at on a line parallel with the axis is cycloidal. I therefore have named it "the cycloidal screw propeller."

Let us now determine the thrust of the cycloidal screw by the same method, as with the horizontal screw, Fig. 1, the number of turns being the same in both cases. The area being 24 square feet, the pitch velocity 6 feet per sec., $24 \times 6 = 144$ sq. ft., the number of feet passing through the disc in a second; the reaction or thrust is $2 \times 144 \times 1 = 288$, only one-half that of Fig. 1, if there be no allowance made for the constant velocity of the water in Fig. 1. *Yet in my experiments it was demonstrated beyond all doubt that the incline screw gave as great a speed upon the boat with less power.*

To maintain the same forward push upon the boat, the thrust of the inclined screw should be double that of the horizontal, when by the same rule it is only one-half.

I account for the result by the constant velocity of the water in the horizontal screw diminishing its thrust, and also by the inclined screw putting in motion a larger body of water than passes through it, increasing its thrust.

The transverse area of the stream of water that is put in motion in one second by a cycloidal screw is greater than the area of the screw. If the screw were about five and one-half feet in diameter, three feet pitch, and moved ten feet forward, making two turns in one second, it would put a stream of water in motion whose cross section would approximate seventy-two square feet.

The number of cubic feet acted on would be $72 \times 6 = 432$; the thrust would be determined by (mass 2) $\times$ 432 (number cubic feet) $\times 1$ (velocity) = 864 lbs.

The power applied to the screw in the two cases is the same.

In Fig. 1, it is the pressure upon the screw disc multiplied by the pitch.

In Fig. 2, it is double the pressure, multiplied by one-half the amount of pitch, which gives the same result in both cases.

I will now consider the comparative economy of power in the two cases.

The diagrams 3,4,5 and 6 are intended to represent the action of the two screws during one revolution, by the equivalent lateral or transverse movement of an incline or wedge. The dotted line $B\ D$, shows the angle at which the water is moved backward by the screw, the reaction being in the direction $D\ P$, the other sides $D\ C$ and $C\ B$, of the right-angled triangle $D\ C\ B$, show the side or lateral reaction in the direction $D\ C$, and the forward or propelling reaction in the direction $C\ B$. If the force of the reaction be taken as the square of the velocity, it follows, $D\ C^2 + C\ B^2 = D\ B^2$.

The reaction of the stream thrown back by a screw, if the vessel be fast to the dock, is as the square of the velocity of the stream.

If the vessel be under way it is not the same, but must be computed by Rankine's method, which is fully as favorable to the Cycloidal Screw. I have, however, computed the economy on the basis of the reaction being as the square of the velocity, for the reason that without further experimental data it is hard to get at the number of feet acted on by the Cycloidal Screw, as it puts in motion a very much larger body of water than passes through its disc.

In Fig. 1 we have a screw with a pitch of one and one-half diameters, or the pitch is equal to one-half of the circumference.

Fig.10

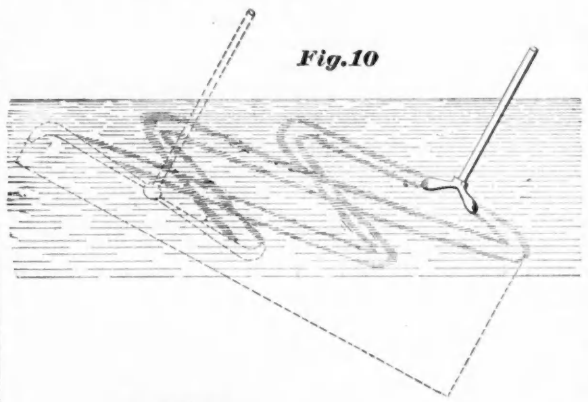


Fig.8

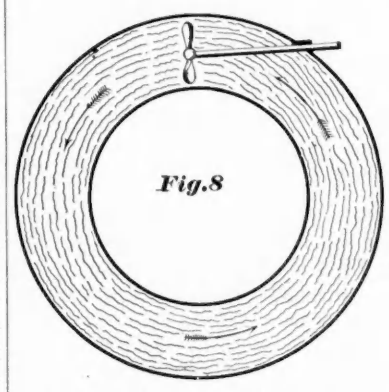


Fig.11

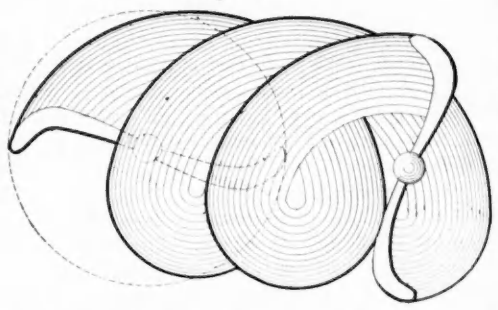


Fig. 3 is a diagram of it, in which $A\ B$ is the circumference, $B\ C$ the pitch, and $A\ C$ the angle of blade at its outer end.

The dotted lines at left and right hands of the diagram represent the commencement and end of a movement from right to left, that would move a particle of water from B to D at right angles to the surface of the blade. The particle would be pushed astern, the distance from B to C, and would be moved sidewise from C to D.

It is evident, that the movement sidewise from C to D is a loss, and that the screw must make one and one-fourth turns, to move the particle astern the distance from B to C, which is a loss of 20 per cent. of the power by side action. The movement of the outer end of the blades is represented by $A\ B$ and $C\ D$. $A\ B$ being one revolution, and $C\ D$ the excess of one revolution necessary to overcome the side action.

Fig. 4 is a diagram of the cycloidal screw of Fig. 2, the diameter is made just one-half greater than Fig. 1.

To avoid fractions, the area of disc being somewhat more than double.

The loss by side action at the ends of the blades, in this case is only 2.7 per cent. The loss in both cases at the ends of the blades is very much less than in any other point, therefore we must take a point, between the center and ends of the blades, to get a fair average of the comparative loss by side action in both cases.

I take that point to be one-fourth the length of the blade from the end, which gives the loss.

31 per cent. on Fig. 1, and
05 " " 2,

Figs. 5 and 6 are the diagrams showing the side action at one-fourth the length of the blade, from the end. If 100 H.P were applied to driving the screw in each case, the amount of power that would be utilized in propelling effect in each case would be, Horizontal Screw 100—31=69, Cycloidal Screw 100—5=95 being 37 per cent. in favor of the Cycloidal Screw. It may be asked, Why not diminish the loss from side action in the horizontal screw by diminishing the pitch? Simply for the reason that the number of turns would have to be increased far more than the pitch decreased. If the pitch were decreased one-half, there would have to be given three or more times as many turns to maintain the same force of thrust, on account of the constant velocity of the water, as I have explained. As the loss from friction and thickness of blades increases as the square of the velocity, the loss from these causes would be increased nine times, which would more than neutralize the gain from diminution of side action.

In the foregoing, I have not considered the change in the action, at different points of their revolution, of the blades of the screw, caused by the incline of the axis.

If they are attached rigidly to the shaft, there is a difference in the action of the blades, when they are across or at right angles to the line of motion of the vessel.

When they are moving forward and downward they act with more pitch than when they are moving backward and upward.

To avoid this unequal action, I attach the blades to the shaft by a cross bearing, or hinge, that causes the action of the blades to be automatically equalized and entirely overcomes any loss by the unequal action.

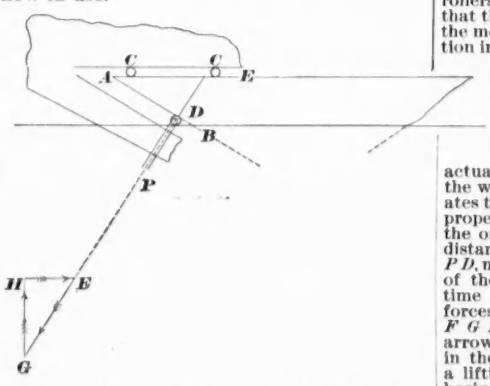
Fig. 7, shows the construction of screw with equalizing blades. The gain by the lifting thrust of the inclined screw is considerable.

Upon the small boat with which I have made my experiments, I make it nearly equal to one-tenth of the displacement; with large vessels it would not be as much.

The frictional loss of the two methods of applying the screw is to be considered.

In Fig. 2, the inclined screw having about one-half more diameter, would have more friction than the horizontal screw of Fig. 1, if the surface of the blades was increased as the diameter. But the pitch being only one-half, the blades may be only one-half the width or less, which will make the friction in the two cases very nearly the same.

I have come to the conclusion, based upon the foregoing comparisons, verified by experiments, that I can safely claim for the cycloidal screw, placed at 60 degrees incline, an economy of 30 per cent. over the method now in use.



This saving results from the fact that there is less loss from side action of the screw, less diminishment of the hydrostatic pressure against the stern lines, and less resistance of hull to be overcome, by reason of the lifting action of the screw upon the vessel.

If, however, there were no losses from the above causes there would still be a loss of power by the screw, as compared with that required to give the same speed if the vessel were towed, and only the power applied to the tow line considered. I believe that it is conceded by eminent engineers that the loss by the present system of screw propulsion is between 50 and 60 per cent. of the power.

It is my opinion that the power required to propel a vessel a given distance at a given rate of speed, by either of the following methods, would approximate

Tow line,	1.
Cycloidal screw,	1.33
Horizontal screw,	2

With a screw of only 14" *pitch, with axis at* 60° *incline,* 180 *revolutions propelled the boat* 360 *feet, the travel of the pitch of the screw being only* 210 *feet.*

Here is a solution of the negative slip problem. In Burgh's book on the screw propeller, there are numerous cases given where the speed of the ship was greater than the progression of the pitch of the screw.

To my mind the cause is the rising and converging of the water at the stern, causing the water to enter the screw at an angle to its axis.

This diminishes the velocity of approach, and there is more velocity to be imparted to the water by the screw.

It will be obvious that the cycloidal screw can be applied by inclining it sidewise instead of downward.

In the foregoing I have confined myself to an angle of 60° for the incline of the axis of the screw, but it is evident any angle of incline will be subject to the same principles of action. The greater the angle of incline, the greater the theoretical gain. The practical limit is the angle, at which the increase in the size of the screw would increase the friction, so as to offset the gain from the less angle of the blade.

I append a communication from the eminent engineer, Charles E. Emery, that fully elucidates the principle upon which the thrust of the inclined screw operates to propel the vessel:

ENGINEERING OFFICE OF CHAS. E. EMERY,
16 Courtland Street,
NEW YORK, February 24th, 1881.

JOHN B. ROOT, Esq.,
28 Cliff Street, New York:

Dear Sir: I am in receipt of yours of the 21st inst. asking, in substance, my opinion of the following statement of your pending application for patent on the subject of screw propulsion.

You say, "I have discovered that by giving the shaft of a screw propeller a sufficient inclination in a direction downward and backward to the line of movement of the vessel, and by increasing the diametric or propelling area of the screw, relatively to the inclination of the shaft, the vessel can be propelled very much further by a given number of revolutions of the screw, than the pitch of the screw multiplied by the number of its revolutions would call for, provided the shaft was placed nearly parallel to the line of the keel as usually applied."

I see no reason to doubt the accuracy of the above statement. Now that the discovery is made and the effect of such an arrangement pointed out, it is evident to me that the result stated is a necessity, as much as in any machine for increasing speed where a given force at a given speed is converted into a less force at a higher speed. The result would, however, not be obvious to those infrequently occupied with such problems, so a number of illustrations will be in point.

We force a wedge in a piece of timber, and the wedge moves inward faster than the crack is opened, so the operating force moving through a certain distance produces a greater force moving through a less distance. Now, if the timber be green and tough, the crack may close through the less distance and exclude the wedge, causing it to move further than the sides of the crack move toward each other. So, in any case, a force acting on an inclined surface may move the same at an angle faster than the force itself moves. For instance, it is easy to see, in the sketch, that if a force be applied in the line $P\ D$, against one incline of a wedge $E\ A\ B$, and the face $A\ E$, be guided by rollers $C\ C$, running against a stationary support, that the wedge will be forced to the right, and that the motion to the right will be faster than the motion in line $P\ D$, when the angle $E\ A\ B$, is less than a right angle. By considering that this simple diagram is attached to the stern of a vessel, it illustrates your discovery. The propeller, thrusting downward and backward in the direction $D\ P$, produces a corresponding reacting force in the direction $P\ D$, which force has two components, one a lifting force, which actually lifts the hull of the vessel a little out of the water, so that the weight thus supported obviates the necessity of the rollers $C\ C$; the other, a propelling force to the right, less in intensity than the original force but moving through a greater distance—since the force which acts on the line $P\ D$, moves only a distance represented by the pitch of the screw multiplied by the revolutions in the time considered. The intensity of the several forces are represented by the sides of the triangle $F\ G\ H$, and the directions of the same by the arrows; the action of the screw moving the water in the direction $F\ G$, with a force $F\ G$, producing a lifting force $G\ H$, in the direction $G\ H$, and the horizontal propelling force $H\ F$, in the direction $H\ F$. Motion of the hull upward, in the direction $G\ H$, ceases as soon as the displacement is reduced sufficiently to balance the lifting force—part of the weight of the hull being continuously carried on the screw—hence all subsequent motion takes place in the direction of the line $H\ F$, and in order to make the work done, excluding friction, the same in the direction $H\ F$ as in $F\ G$, the motion in the direction $H\ F$ must be as much greater than that in the direction of the line $F\ G$, as $F\ G$ is greater than $H\ F$, a necessity which follows the general law of virtual velocities.

The thrust of your inclined screw being greater than that of one with horizontal shaft, your position is right—that a larger diameter will be necessary to maintain the same rate of slip, and the pitch may also be reduced if desired to reduce the size of the propelling engines.

It will now be seen that the principle is the same as that of a wind blowing angularly on the sail of an ice boat, where the speed of the boat is not limited to that of the wind.

The conception is novel to me, and I not only believe it to be founded on sound principles, but capable of development so as to be of great practical utility. Very truly yours,

CHAS. E. EMERY.

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NEW YORK, NOVEMBER 26, 1881.

CONTENTS.

PAGE.
New Circular Saw Table and Boring Machine.... 1
The Heating of Journals..... 1
Cone Pulley Diameters No. 3. By J. F. Klein... 2
A New Turret Head Tool..... 3
A New Foot Power Treadle..... 3
New Wire Straightening and Cutting Machines 4
A New Method of Keeping Mechanical Drawings. By Chas. T. Porter..... 4
Tapping Out and Stopping up Cupolas. By Thomas D. West..... 4
Letters From Practical Men—A New Hammer—Short Belts—Ocean Steamers for Passengers—Iron Foundry Economies—How to Help Apprentices..... 4
An Improved Method of Screw Propulsion. By John B. Root..... 6
Some Industrial Problems..... 8
A High Standard of Mechanical Work..... 8
Unstable Location of Machinery..... 8
Broken Steamship Shafts..... 8
Literary Notes..... 9
Questions and Answers..... 9
Manufactures..... 9
Newly Incorporated Companies..... 9
Machinists' and Engineers' Supplies..... 10
Iron and Metal Review..... 10

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Some Industrial Problems.

Increasing activity in all of the useful arts, brings us face to face with industrial problems which demand a solution. We may postpone action for a time, but the necessity for taking up and satisfactorily disposing of these problems becomes more pressing as productive enterprises multiply and enlarge. Next to the apprenticeship question, and closely related to it, comes the question of free public technical education. The common schools can not properly be made to enlarge their sphere of operations so as to impart technical education, yet in many cases they devote considerable attention to what must be regarded as strictly commercial instruction. If clerks, bookkeepers and accountants are to be trained up at public expense, why not mechanics and artisans? The latter are of more value to the community than the former. The State often endows colleges and pays for the training of teachers in private academies, in addition to supporting its own normal schools. It would seem to be as much a public benefit to educate a few mechanics at public expense in private establishments, as to educate teachers in like manner. There is a greater scarcity of good mechanics than of good teachers.

A problem of the highest importance both to employers and the community at large is the securing of greater comforts and means of improvement to workmen. Better homes, at the same cost, should be secured in large cities. Libraries, reading rooms and places of rational evening amusement should be provided in the smaller towns. Some employers have taken hold of this problem in a way that deserves the highest credit, and is worthy of imitation by others. The larger number, however, seem to consider it foreign to their individual interests—a mistaken view of the situation.

Another problem, the solution of which seems very far off is full co-operation among leading establishments in conducting expensive mechanical experiments, beneficial alike to all those engaged in mechanical pursuits. Where the benefit to be derived is private in its nature, no co-operation is desired; but where the results, if made public, would be as valuable to others as to those conducting the experiments, some common ground for action should be taken in the interests of mechanical progress. Very few establishments are wealthy enough to conduct such experiments privately, and scatter the knowledge thereby gained without any compensation; or, if wealthy, are actuated by any such high motives of public benefaction. But, united upon a common plan, a number of leading establishments could carry out, at small expense to each, some of the most needed experiments, valuable to themselves and to all others engaged in like pursuits.

A High Standard of Mechanical Work.

A noteworthy characteristic of the present somewhat remarkable demand for the product of our machine shops is the exceptionally high quality that is demanded. Buyers are looking for machinery in excess of immediate probabilities of having their wants supplied, yet they are by no means willing to compromise on an inferior article. Many of our readers have not forgotten the complaints, during the flush times from 1862 to 1872, that the demand for machinery, and the difficulty with which it was supplied, had a marked influence in lowering the standard of excellence. Men then, as now, were anxious to buy, and were generally willing to compromise on almost anything that in some degree represented their wants. The result was that a large amount of machine shop *shoddy* found its way into existence and into use. That was pre-eminently the time of quantity rather than quality, and it had the direct effect of lowering relatively, if not positively, the standard of excellence; that is, if the world of buyers were not satisfied, at the end of the ten years noted, with an inferior product (with reference to the quality demanded ten years previous), they did not demand anything in a degree better to correspond with the improvements that ten years ought to show.

We are by no means asserting that some manufacturers did not go on during these ten years progressing in the way of excellence; for, on the contrary, they undoubtedly did do so, and just as undoubtedly did find during the succeeding dull times, and especially are finding at the present time, a substantial reward for their efforts; but there was by no means the same immediate encouragement, or, rather, there was not the same absolute demand for progress that exists to-day.

Take for instance two prominent machine industries—those of machine tools and steam engines—and during the time referred to the demand was in many instances satisfied by products of an inferior quality; products that at the present, notwithstanding the supply is below the absolute want, will not be accepted. This is altogether satisfactory, because it denotes progress. The logic of this is that not only those who manufacture and sell the machines are better educated to the needs of those who use them, but that those who buy and use them are better qualified to judge of their own wants. This is particularly true in reference to the steam engine trade, in which it seems useless for the manufacturer to go into the market unless he can satisfactorily demonstrate points of excellence. As a result of this, from a few builders—readily counted on the fingers—who built up to the knowledge of the day, and who were exceptions to the general rule, the number has steadily increased until the rule is first-class production in the light of modern understanding. Under the impulse of the present demand, based on more general information, there is every evidence to look for further progress and inducements for the manufacturer to employ all his skill in the way of progress, that certainly were lacking in the flush times fifteen years ago.

On the whole, we believe the fact, that, notwithstanding the excess of demand over supply, success in the machine business is to-day more a question of actual merit than ever before, is altogether satisfactory to the enterprising manufacturer, and an evidence of material progress.

Unstable Location of Machinery.

In our extracts last week from the paper "The Mill Floor and its Supports," read before the American Society of Mechanical Engineers, by C. J. H. Woodbury, are some points of general interest worthy of more attention than they are likely to receive. We refer particularly to the author's statement that "It requires 20 per cent. more power to run the spinning frames in a mill which vibrates, than in one which runs steadily."

It will be conceded that Mr. Woodbury has exceptional advantages for gaining information on this subject, and if 20 per cent. of the power is expended in putting the mill in vibration and in increased friction, due to a consequent disturbance of the alignment of journals, etc., in the instance of spinning frames, it would seem reasonable that a much larger percentage of power than is usually conceded, is absorbed by machinery generally, when supported on improper foundations, or by running it in an unbalanced condition.

It is not uncommon to see unbalanced pulleys on shafting shaking a building to its foundation, or to see some quick-running machine on a floor making the entire building uncomfortable; and while it is well understood that machinery thus operated wears out more rapidly than when properly balanced and substantially located, we question if the consideration of how much coal it costs to put a large building into a state of uncomfortable vibration, and to operate machinery under a condition of friction that brings about its destruction in one-half the time it ought to last, has ever received the attention it deserves.

There is here a fruitful field for investigation, and one of undoubted interest and importance, in which any one who pays the coal bill for running machinery is directly interested.

Steam engine builders have come to understand the importance of solid foundations, mainly because they are absolutely necessary to the satisfactory working of their engines, but in respect to the effect of the injudicious location of general machinery, it is probable there is yet much to be learned.

Broken Steamship Shafts.

It has been commented upon as somewhat remarkable that so many steamships are disabled by the breaking of their shafts, and, in some instances, surprise has been expressed that means have not been devised for repairing a broken shaft at sea. With reference to mending a broken propeller shaft at sea, while, in one or two instances, in the case of shafts of moderate size, and under peculiar conditions of the break, they have been so mended, generally speaking, as they are at present constructed, this is quite impossible, and if those who commented upon this matter had a better general knowledge of the difficulty attending the mending of a large propeller shaft, with the vessel in port, their surprise in this respect would probably be materially modified.

Undoubtedly propeller shafts fail much more frequently than formerly, because the number of steamships is constantly increasing, but mainly because the greater power of the engines in use calls for shafts of much larger diameter, and the difficulties in the way of getting sound forgings of large shafts is very much greater than in the instance of small ones. Sometimes the defect in the forging shows itself at once, but, in the majority of cases, it is not found till a break occurs when in actual use. It is probably very seldom that a shaft breaks because it is not as constructed—that is, with the weakness that may, and probably does exist somewhere in it—strong enough for the purpose, but because the location of the bearings is on a foundation entirely unstable in its character, and the shaft is, to use a common expression, never in line, and never out of line twice alike; whence, it follows, that in its revolution it is constantly being bent one way and another, until finally the breaking, which has been going on with every revolution, is completed; occurring, of course, at the weakest place, whether that weakness has been developed wholly by the breaking process to which it has been constantly subjected, or partly by that and partly from original imperfections. In any event, the breaking process is usually one of long duration.

If the structure of an iron shaft could be depended on as being uniform throughout its length, it would seem probable that it might be so made as to bring about its breaking (if it broke at all) at a determined point, and that by a proper construction, provision might be made for mending, or bridging the break quite readily. Even with the lack of homogeneity it is by no means certain that this could not be done.

If the different sections of the shaft could be coupled between the bearings with flexible universal couplings in such a way as to leave each section at liberty within reasonable limits to align itself without being influenced by the other sections, much of the difficulty would be overcome. This would imply the construction, or, more than that, the invention, of a coupling that should be perfectly free in its movement, and still without backlash, and strong enough to transmit several thousand horse power, or, stronger than the shaft; a mechanical problem of considerable magnitude, but perhaps not impossible.

With reference to the use of steel shafts, which it is sometimes claimed would meet all the requirements, it is at least a matter of doubt. Steel shafts are by no means to be depended upon as to their quality of homogeneity, and in the instance of very large ones it is problematical if they are much better in this respect than carefully made iron ones; besides, the faulty alignment would operate to break steel as well as iron.

Altogether, with the constantly increasing size of steamships, the demand for greater speed, and hence correspondingly increased engine power, the question of a shaft that will stand the strain for a great length of

time, under the conditions which the shaft of a steamship is run, is an important one; while the increasing frequency of steamships being disabled from broken shafts, and the danger of loss of life from such accidents, makes the subject worthy the serious attention of engineers.

That the difficulty should present itself is what might be expected, but that it is not more promptly met is hardly creditable to the engineering ability of the day.

In commenting on an advertisement that recently appeared in a Philadelphia paper,—"Wanted: a boy about seventeen years old, to run a steam engine; no man need apply"—the *Philadelphia Record*, after the statement that many boilers in that city are left to the care of boys, says: "although the Department of Boiler Inspection is empowered to examine such applicants as present themselves, and to certify to their abilities, it cannot compel a single steam user to replace an incompetent man with one skilled in his duties."

Of course, it can't. The object of such laws are to provide a way for not doing a thing, and to enable the disinterested citizen to get blown up legitimately—that is, according to law. Looked at in this light they are a triumphant success. No one expects more than this from them. The *Record* has no occasion, however, to flatter itself that Philadelphia has a corner in this business. There may be some differences in the peculiar *quality* of the laxity of inspection laws in different localities, but they amount to the same thing in the end. As it is, the only substantial protection brought about by enforced inspection is in that of the boiler insurance companies; but that, unfortunately, can reach no further than the inclination of interested parties permit; so that on the whole, until those who legislate take hold of the matter in something like a business manner, we must take our chances and charge the consequences to luck.

We give place this week to a lengthy paper on "A New Method of Screw Propulsion," by J. B. Root, read at the last meeting of the American Society of Mechanical Engineers. This paper called forth a very sharp discussion, which we shall present (from our stenographic report) next week. If Mr. Root is correct, his method of using a screw propeller is an important innovation in marine engineering.

It is said that in 1879 a watchmaker of Vouvrey, Switzerland, who claimed to have invented a watch that would run for years without winding, placed in the keeping of the municipal authorities a box containing two watches, which was sealed, and upon being opened, recently, the watches were running regularly.

The need of more machinists who are skillful is felt almost everywhere throughout the Eastern section of the United States, but we hear from several sources that Chicago is peculiarly happy in being well supplied.

Manufacturers that are obliged to depend upon water power have been greatly troubled by the recent drought. Many of them have concluded that a good steam engine is the surest thing to depend upon for power.

The paper on the Heating of Journals, from which we make extracts this week, was sent us by the author with the modest request that his name should not appear with it.

Literary Notes.

The *Milling World*, of Buffalo, has changed from a monthly to a weekly issue. It comes out with sixteen pages, same size as the AMERICAN MACHINIST, is very well made up as to contents, finely printed, and has fixed its subscription price at $2 a year.

The *National Scientific Journal*, of Chicago, has reached its fifteenth semi-monthly issue. It is a sixteen-page illustrated journal of high scientific character, and contains much interesting and valuable matter for the general reader. $2.50 a year.

Several of our industrial exchanges have donned overcoats this fall—those that never wore them before. The colors vary from the light brick tint of the *Chattanooga Tradesman* to the subdued coffee color of the *Railroad Gazette*.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) T. G., New York, writes: We have three horizontal tubular boilers, used for heating, building and running steam elevators; one for elevators and two for heating. On elevators we carry 45 pounds pressure, and on building from 10 to 15 pounds. Two of the boilers are 4 feet by 12 feet, with 48 3-in. tubes; fire box 4 feet 3 in. by 5 feet. One is 3 feet by 12 feet, with 30 3-in. tubes; fire box 3 feet 4 in. by 4 feet. The small boiler has 4 in. space between top of tubes and lower gauge cock, and 12 in. space between top of tubes and shell of boiler; and 20 in. by 24 in. dome. The top of combination is taken from side of dome; also connection for house and engines. The large boilers, whether on house or engine, work as nicely as any boilers can, but the small one, whether on house at 10 pounds or engines at 45 pounds, will lift the water so that we cannot tell where it is. Can you tell me from above description the cause, and the remedy, if any? *A.* So far as you have described the boiler, we see no cause but insufficient steam room, due to the fact that the tubes are placed too high in the shell of the boiler. Sometimes the connections to the water line are made in such a manner that they do not properly indicate the height of water, and sometimes they get partially stopped up, and are deceptive in the indication of water level We presume, however, that you have other evidence of priming. According to your statement, there would be but 8 inches of steam room with one gauge of water, or with two gauges say 4″ or 5″, which would account for priming under almost any circumstances. If your boilers have very careful attention you might place a gauge cock two inches above the highest end of the flues and run with less water than at present. We see no complete remedy, however, except in putting in new heads, with the tubes differently arranged.

(2) P. C., Virginia City, Nev., writes that he is a blacksmith, and has, in common with many others, difficulty in tempering the springs used in the safety device for the mine cages. The spring is a plain spiral (not conical) and is made from spring steel ¼″x1¼″. He says he heats the spring to a cherry red and cools in lard oil, but that after two or three days the temper is all gone. Other processes of tempering result in a brittle spring that soon breaks. The shafts are of a temperature of about 80°. *A.* We recommend that you use whale instead of lard oil. The trouble may be in the quality of steel used. To test this take a piece, say 10″ or 12″ long, heat, harden and then blaze off in oil, and test the quality of the temper. Perhaps the steel will not harden in oil, in which case it is not fit for a spring. Some kinds of steel require higher heat than others, which you must determine by experiment. We are not sure from your letter but you temper in oil without blazing at all. If so you will not succeed. You will have to blaze to a blue, judging of the temper by the color of the flame.

(3) A. S., Haverhill, Mass., says he has engineer's papers, and asks where he can get a situation. *A.* We know of no other plan than that of making your desires known to those who would be likely to want engineers.

(4) A. S., Elizabeth, N. J., asks for detail drawings of a small steam hammer. *A.* We have no such drawings at hand and do not know where they can be obtained.

(5) C. F. P., Chicago, Ill., writes: Please decide for me as well as other of your readers what a worm is, mechanically speaking. Certain screws are designated as "worms" by machinists, and, I think, incorrectly, *A.* One of Webster's definitions of the word worm is: "A short revolving screw, the threads of which drive a wheel by gearing into its teeth or cogs."

(6) W. H. M., Rushville, Ind., writes: Will you please answer the following: Suppose there to be a hole through the center of the earth, and I were to let a ball, say, of 100 lbs. weight, fall from the surface, at what point would it stop? I maintain that it would stop just at the center, because as it approaches the center the attractive force is diminished, so by the time it arrives at that point, it will be equally attracted in every direction. My friend differs from me. He says it will attain such a velocity that it will be carried beyond the center, and finally come to a state of rest at the center. Which is right? *A.* We think your friend is right.

(7) F. M. H., Fitchburg, Mass., says he is a fireman, and asks us if we will furnish him with drawings for a locomotive on a scale of 1″ to the foot, or if not, if we can tell him where they can be had. He wishes to make a model. *A.* We have no such drawings, and cannot tell where they may be had except by procuring some one to make them. If, as we infer, F. M. W. is a young fireman, and wishes to make a model for his own instruction, we would suggest that he make his own drawings from measures which he has abundant opportunity to take. As a means of instruction he will find this plan one of great value.

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A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price. $2.00, Mailed by E. & F. N. Spon. 446 Broome St., New York City, on receipt of price.

MANUFACTURES.

Tanner & Faxton, of Lee, Mass., will rebuild their paper mill that was burned last year.

The Lobdell Car Wheel Co., are about to erect a new rolling mill near Wilmington, Del.

The Nashua Manufacturing Co., Nashua, N. H., have bought the fair grounds in that city.

The Chicopee Manufacturing Company, Chicopee, Mass., have begun the erection of a new 500-loom mill.

The American Bolt Company, Lowell, Mass., recently filled an order for 140,000 bolts from South America.

The total amount of the capital stock of the Rockford Sewing Machine Co., Rockford, Ill., has been subscribed.

The new mill of the Amoskeag Manufacturing Co., at Manchester, N. H., will be lighted with 200 electric lights.

The citizens of Grand Forks, Dak., are making efforts to secure the building at that place of a large flouring mill and elevator.

One day recently 60 lathes were waiting transportation at the Pratt & Whitney Company's Works, Hartford, Conn.

A large brick paper mill has just been completed at Burnside, Conn. It will be equipped with new machinery throughout.

The Nordyke & Marmon Co., of Indianapolis, Ind., are filling an order for a line of flour-making machinery from Tyzabad, Hindoostan.

The Brooks Locomotive Works, Dunkirk, N. Y., has the contract for sixty first-class locomotives for the New York, Chicago & St. Louis Railroad.

It is said that Mr. Sayre, of the Bethlehem Steel Works, has completed arrangements for the erection of extensive steel works at Birmingham, Ala.

A large silk and woolen mill is to be erected at Philadelphia, Pa., to be known as the Bay Brook Mills. Philadelphia and Eastern capitalists will furnish the capital.

The *Industrial World* is authority for the statement that a project looking to the starting of a sewing machine manufactory at La Crosse, Wis., is on foot.

Hussey, Howe & Co., steel manufacturers of Pittsburgh, Pa., are about to enlarge their plant, having purchased a plot of ground 100x180 feet for that purpose.

A locomotive manufactory is to be started in Syracuse, N. Y. A. J. Belden is Treasurer of the company, which has already commenced to purchase machinery.

The 50-horse power engine built by Kendall & Roberts, Cambridge, Mass, and now running at the Institute Fair at Boston, has been purchased by H. L. Crandall & Co., of Ashaway.

The Cohoes Iron Foundry and Machine Co., Cohoes, N. Y., will issue a new catalogue and book of handy reference for manufacturers. It will be a price list of supplies for shops, mills, etc.

S. Ashton Hand, Toughkenamon, Pa., has a force of 18 men at work building engine lathes, for which he has a good demand. New tools and additional facilities for turning out work are being constantly added.

The Wilmington Malleable Iron Co., of Wilmington, Del., have purchased the business of Richard P. Pim, and will hereafter carry on the manufacture of malleable and gray iron castings with greatly increased facilities.

The Woodruff Iron Works, Hartford, Conn., recently shipped a pair of V grooved friction wheels to the Central Mining Co, of Mich., each of which weighed more than 11,000 pounds. They were 12 feet in diameter.

The Indianapolis Steel Rail Mill has just purchased an engine and boiler outfit of the Atlas Engine Works, and Burkhardt & Co., Cincinnati, have purchased the Atlas "Gold Medal" slide valve engine that was in the Exposition.

The Buckeye Engine Co., Salem, O., have recently received an order from the Merrimac Manufacturing Co., of Lowell, Mass., for a pair of 28″x48″ engines; also for two large pumping engines from the Moulton Mining Co., of Butte City, Montana.

One of the firm of the Pittsburgh Steel Casting Company has applied for a patent on a process for making blooms, billets and various shapes, such as channels, angles, etc., of Bessemer steel, at a saving of at least $6 per ton, as well as two and one-half per cent. waste of material.—*Commercial Bulletin.*

Recently Woolworth and Graham obtained a patent for water-marking money-order paper, and have just assigned the right to its use to the government. The use of this water-mark will add to the difficulty of counterfeiting postal money orders, as no reputable mill will try to imitate this paper.—*The Paper Trade Journal.*

A NEW PAPER MILL.—John A. Manning, of this city, has leased for ten years the extensive Crystal Palace flour mill at the state dam, belonging to the estate of the late Francis S. Thayer, and will convert it into a manilla paper factory during the winter. Paper will be made for Arkell & Smith's bag factory at Canajoharie.—*Troy Daily Times.*

The Indianapolis *Journal* says: "Within the next sixty days the locomotive power of several of the Indianapolis roads is to be largely increased. Many of these orders were placed nearly a year ago. The Baldwin Locomotive Works are now building five heavy freight engines for the Indianapolis & St. Louis Road of the same pattern as those placed on the Bee Line within the past few months. The Pennsylvania Railroad Company is rebuilding ten heavy freight engines for the Vandalia Road; five will be here within 20 days, and five more a month later. The Indiana, Bloomington & Western Road is to have 22 new engines within the next 90 days. Two will be here this week, and will be put in service on the I. B. & W. proper. Eight of these engines are built at the the Danforth, eight at the Rogers, and six at the Brooks Locomotive Works, and all are to be first-class in every respect. The Brooks Locomotive Works are also building six engines for the Cincinnati, Indianapolis, St. Louis & Chicago Road—three freight engines, two switching and one for passenger service. At the Manchester Locomotive Works they are building ten engines for the Detroit and Indianapolis division of the Wabash Road. Two have already been received, and two more will arrive this week. All are heavy freight engines. At the Cleveland shops of the Ohio Railway two new engines are on the stocks, and will be completed and in service before Christmas, and the power of the Pittsburgh, Cincinnati & St. Louis Road is to be immediately increased ten engines, six of them first-class heavy passenger engines and four freight engines. All will be placed on the Indianapolis division."

Newly Incorporated Companies.

ILLINOIS.

The Uniform Barrel Manufacturing Company, Chicago; A. C. Blount, Thos. H. Martin and Robt. T. Martin, corporators; Capital, $100,000. The manufacture and sale of barrels, kegs, hogsheads and barrel-making machinery.

Rogers Foundry Company, Belleville; Robt. Rogers, E. Rogers and Geo. N. Rogers, corporators; Capital, $25,000. The manufacture of stoves, machinery castings and a general foundry business.

Gratiot Manufacturing Company, Chicago; Chas. L. Gratiot, Arthur H. Chetlain and Hempstead Washburn, corporators; Capital, $100,000. To manufacture and sell roller mills, mill machinery of every description, and other articles and implements.

The Lake Gas Company, Chicago; Jno. O. Wilson, Irus Coy and G. F. McKnight, corporators; Capital, $200,000. To manufacture and furnish gas to the town of Lake, Cook Co., Ill.

Chicago Malt and Grain Company, Chicago; Jas. G. Meek, Jno. B. Niefert and Charles Gottschalk, corporators; Capital, $50,000. The manufacture of malt and the handling of grain generally.

The Wright Fire Proofing Company, Chicago; Harvey B. Merrill, Thomas Ferguson and Peter B. Wright, corporators; Capital, $100,000. To manufacture, apply and deal in fire proof materials.

The Duluth Lumber Company, Chicago; Robt. L. Henry, Samuel K. Martin and Henry S. Osborne, corporators; Capital, $300,000. The manufacture and sale of lumber in all its branches, etc.

The National Cylinder Company, Chicago; Edward H. Walker, Arthur S. Wright and Jno. F. Temple, corporators; Capital, $75,000. The manufacture and sale of enameled cylinders for wood and metal pumps, and enameled water pipes, and doing a general manufacturing and jobbing business in the materials used in manufacturing wood and iron pumps.

Machinists' and Engineers' Supplies.

NEW YORK, Nov 10, 1881.

Unless there should be a temporary lull in the demand for supplies, there is little chance for the manufacturers to gain any headway. At present, goods are taken away as fast as they are manufactured, and there are no heavy stocks being carried in any part of the country. Considering the lateness of the season, the amount of business transacted is remarkable.

The Worswick Manufacturing Co., of Cleveland, O., are preparing a new catalogue, accompanied by a price list, both of which will be ready soon.

Wrought Iron Pipe continues to stiffen, and some sizes are still practically out of the market. Prices remain unchanged at 55 to 57½ per cent. discount on Gas and Steam pipe, and 40 per cent. discount on Boiler Tubes.

The Stanwood Pipe Cutters, also the Packer Ratchets, are still very scarce.

Bolts and Nuts have recently advanced 10 per cent., also Set and Cap screws from 5 to 10 per cent.

Large Lathes, from 24" to 36", are not to be had, and large Planers are also very scarce.

There is an active demand and a fair supply of upright Drill Presses.

In Twist Drills, the market is fairly supplied with the regular goods, and the demand is very steady.

Iron and Metal Review.

At present there are immense quantities of Pig Iron going directly into the hands of consumers. The general state of the market is good, and the dealers appear to be well pleased with the condition of things.

We quote prices as follows:

Foundry No. 1, $25 to $26; Foundry No. 2 X, $23.50; Gray Forge, $22.50. The demand for Foreign Iron continues active, with prices as follows: Gartscherrie, $25 to $25.50; Coltness, $26.50; Langloan, $26; Summerlee, $26; Glengarnock, $25; Carnbroe, $24.75; Eglinton, $23 to $23.50.

The active demand for Steel and Iron Rails continues with prices unchanged at $60 for Steel delivered next year and Iron at $48 to $50. The market for old rails is fair. We quote old T rails at $28.50 to $29 and Double Heads at $31.50 to $32. The demand for Wrought Iron Scrap is good; No. 1 is quoted at $31 for foreign and $32.50 for prime selected from yard. The demand for manufactured iron continues as last reported, and sales large. Copper is in fair demand at 18¼c. to 18½c. for Lake Superior Straits and Australian Tin, 20½c. to 20⅝c.; and Billiton, 20¾c. Lead, 5c. Spelter, Western, 5¾c.; Silesian, 5⅞c.; Antimony, 13¼c. for American and 14c. to 14½c. for Cookson.

WANTED

Wanted—A small second-hand metal planer; hand power. Address, J. E. Downes, Waterloo, N. Y.

Wanted,—Second-hand or New 50 to 75 H. P. Automatic Cut-off, Condensing, Horizontal Engine. Send full details to Box 10, AMERICAN MACHINIST, 96 Fulton Street, New York.

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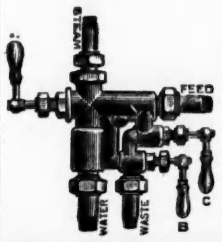

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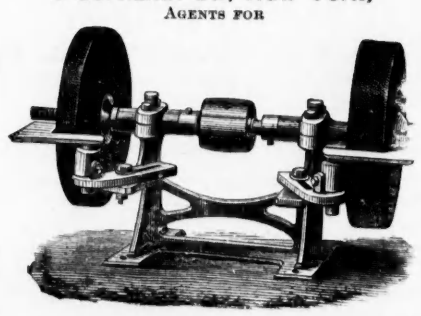
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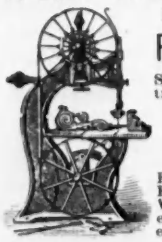
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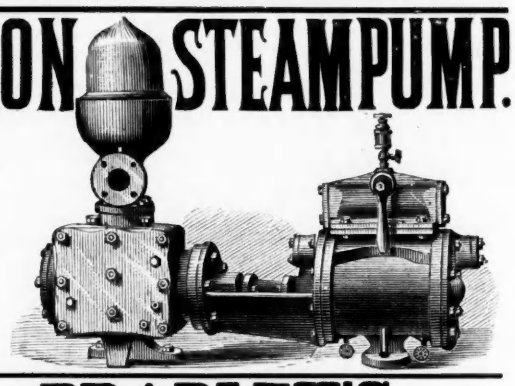

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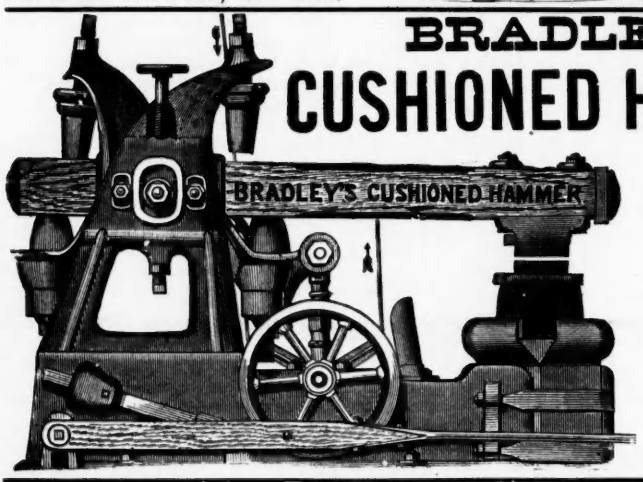

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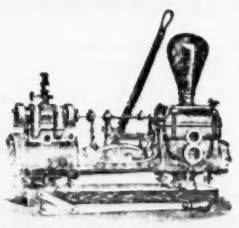
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